Electrical World

The consolidation of ELECTRICAL WORLD and ENGINEER AND AMERICAN ELECTRICIAN.

VOL. 58. NEW YORK, SATURDAY, SEPTEMBER 2, 1911. NO. 10.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

239 WEST THIRTY-NINTH STREET, NEW YORK.

JAMES H. McGRAW, President.
HUGH M. WILSON, 1st Vice-President. A. E. CLIFFORD, 2d Vice-President.
CURTIS E. WHITTLESEY, Secretary and Treasurer.
TELEPHONE CALL: 4700 BRYANT. CABLE ADDRESS: ELECTRICAL, NEW YORK

EDITOR ..... W. D. Weaver
A. S. M'ALLISTER ..... Associate Editor
W. H. ONKEN, JR. ..... Associate Editor
W. E. KEILY ..... Associate Editor
O. H. CALDWELL ..... Assistant Editor
G. TISELL ..... Assistant Editor
W. T. PEACOCK ..... News Editor
S. S. BOIES ..... News Editor
FREDERIC NICHOLAS ..... Special Contributor
J. R. CRAVATH ..... Special Contributor

CHICAGO OFFICE ..... 1570 Old Colony Building
CLEVELAND OFFICE ..... 1021 Schofield Building
PHILADELPHIA OFFICE ..... Real Estate Trust Building
EUROPEAN OFFICE ..... Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION.

United States, Cuba and Mexico, $3.00 per year; Canada, $4.50 per year. All other countries, $6.00 per year. Foreign subscriptions may be sent to our European office.

Requests for changes of address should be made one week in advance giving *old* as well as new address. Date on wrapper indicates the month at the end of which subscription expires.

NOTICE TO ADVERTISERS.

Changes of advertising copy should reach this office ten days in advance of date of issue if proofs are desired. New advertisements will be accepted up to noon of Wednesday of the week of issue.

Copyright, 1911, by McGRAW PUBLISHING COMPANY.

Entered as second-class matter at the post office at New York, N. Y.

The circulation of Electrical World for 1910 was 974,750. Of this issue 22,500 copies are printed.

NEW YORK, SATURDAY, SEPTEMBER 2, 1911.

CONTENTS.

Editorials 527
Fall Convention of New England N. E. L. A. Section 532
Convention of the Association of Edison Illuminating Companies 532
Chicago Elevated Railways Merged by Central-Station Finance 532
Telephone Pioneers of America 532
Deerfield River, Mass., Hydroelectric Development 532
Operation of Consolidated Properties in Ontario, Canada 533
Prize for Electric Lamps for Miners 533
Electrical Code of the City of New York 533
Indiana Electric Light Association Meeting 534
Texas and Electrical Corporations 536
Commission News 538
Current News and Notes 539
Combination Heating and Generating Plant at Springfield, Ill. 541
Downtown Arc Lighting System of Philadelphia 545
Electricity in the Lackawanna Valley, Pennsylvania 549
Observations on the Effect of the Light of the Mercury-Vapor Lamp on the Eye 550
Diversity Factor 552
Operation of Series Alternating-Current Street Arc Lamps 554
Production Cost in Progressive Central Stations 556
Calculation for Flywheels for Piston-Driven Prime-Movers. By George T. Hanchett 559
Steam Kinks and Suggestions. By Charles L. Kintner 560
Electric Fountain Used for Cooling Condensing Water 562
Letters on Practical Subjects 563
Questions and Answers 567
Municipal Plant at Napanee, Ontario, Sold to Town's Advantage 569
Operating Cost of a Gas-Producing Central Station 569
Forestalling an Isolated Plant by Central Station Service 570
Revolutionizing the Building Trade in Denver 571
Recent Tests of the Cost of Electric Cooking 572
Billing and Record System of the New York Edison Company 573
The Testing of Customers' Meters 574
A Modern Central-Station Storehouse and Plant Office 575
LETTER TO THE EDITOR:
Electric Lighting from Three-Phase Circuits 585
Digest of Current Electrical Literature 585
Book Reviews 589
New Apparatus and Appliances 589
Industrial and Commercial News 593
General News 597
Directory of Electrical Associations, Societies, etc. 605
Weekly Record of Electrical Patents 606

FOUR YEARS OF THE TUNGSTEN LAMP.

It is now about four years since the tungsten lamp began to appear in the United States. The fears of some central-station managers that the lamp would cause a serious decrease in revenue, and the hopes of others that it would be a great boon to the business, because of the new basis upon which electricity could compete with other illuminants, have been recited many times in papers dealing with the tungsten-lamp situation. Nevertheless it is interesting to note after four years of use of the tungsten lamp in this country that electric-lighting companies are "still doing business," and, as far as we know, none has been forced into receivership by virtue of the tungsten lamp. On the other hand, it is well known that the tungsten lamp has found its way into places where heretofore gas and gasoline lighting held almost indisputed sway. There has undoubtedly been a small reduction in the gross revenue received from many hundreds of electric-lighting customers because of the change to tungsten lamps, but this has been more than compensated for by increase in the number of customers. On the whole, the electric service business has shown fully its normal rate of increase during the past four years in spite of the tungsten lamp and the 1907 panic. One result of the introduction of tungsten lamps has been a general increase in the amount of illumination considered satisfactory by users of electric light, the tendency having been to use about twice the illumination formerly common. Another tendency has been to light a room as a whole, giving sufficient general illumination in all parts of the room for any of the purposes for which it is used, as contrasted with the localized lighting which was formerly common. This is one of the natural results of economical units of high candle-power. Since with the tungsten lamp it is possible to light satisfactorily a whole room with a lamp taking the same energy as an old carbon lamp sufficient to provide localized lighting only in one part of the room, light users have not felt it necessary to adhere to the old localized system, and have gladly accepted the more cheerful conditions of general lighting. This applies both to the office and to the home. In the office where desk lamps were uniformly the rule general lighting is now the accepted modern practice. In the home the table lamp is now largely an ornament and the room is lighted sufficiently well to admit of reading in all parts.

The tungsten lamp came in about the time the present movement for better illuminating engineering began. As the introduction of tungsten lamps in many cases involved the installation of new fixtures, this gave opportunity for better illuminating design, so that in addition to the increased efficiency of the tungsten lamp the user had the further advantage of better utilization of the light pro-

duced. In some cases this better utilization has taken the form of increased efficiency or a higher percentage of lumens effective per lumens generated. In other cases the efficiency of utilization has been decreased or has remained stationary as compared with former practice, but the use of diffusing globes and reflectors or indirect-lighting systems has been made commercially feasible by the economy of the tungsten lamp and the comfort of users has been thereby much increased and artificial light has been brought nearer to daylight in its qualities as regards diffusion. The sales of carbon-filament lamps have not as yet shown any radical falling off from previous years. Nevertheless, it is a matter of common observation that tungsten lamps have displaced carbon filaments in a large number of places where lamps are used for many hours per year. In other words, although the percentage of tungsten lamps in use is not large yet as compared with carbon lamps, the kw-hours supplied to tungsten lamps yearly are a much larger proportion of the total. There are many places where lamps are used but little, and many consumers have refrained from purchasing a fragile lamp to put in such places and incur the risk of breakage for a very small possible saving in energy used. The recent introduction of wire-filament tungsten lamps, which are not fragile when new, will tend to reduce the number of carbon lamps in use. It is true that such lamps as are now made frequently become fragile with use, but they retain a decided shipping advantage. The tungsten lamp is completely displacing multiple inclosed carbon-arc lamps for interior illumination. It is steadier and more efficient, requires no trimming, and the light is more easily controlled by means of globes and reflectors. Electric-lighting companies have been glad to get rid of the arc-lamp maintenance cost which they formerly assumed, and the customer has received more light for the same money. For the street lighting of small towns the tungsten lamp has shown its great superiority over the standard inclosed-carbon arc lamps, not only in efficiency but in steadiness and in the possibility of supplying it in any size units.

CENTRAL-STATION INSURANCE.

The figures presented at the recent Ohio Electric Light Association convention by Secretary Gaskill on the actual ratio of cost of insurance to losses paid only confirm the facts brought out in previous similar investigations (most notably one in Illinois several years ago) that the premiums paid by central-station companies for fire insurance on power-plant buildings are excessive and have little relation to the actual losses sustained with the business as it is at present under existing conditions of central-station operation. It is undoubtedly true that the stations reporting to Mr. Gaskill made a somewhat exceptional showing, namely, $82,000 premiums to $60 loss. More complete returns would doubtless be more favorable to the insurance companies, but, after allowing for all contingencies, Mr. Gaskill's investigations, as well as others which have been made by central-station state associations and by the National Electric Light Association, indicate that the insurance companies have paid little attention to making their central-station insurance rate equitable, and that the central-station companies are really carrying the burden of other less desirable risks. These matters have been brought to the attention of the insurance interests so many times that it is not strange that central-station managers are beginning to consider mutual insurance, or insurance "by exchange," as about the only feasible way out of the difficulty. A number of central stations operating auxiliary ice plants have been able to realize the practical benefits of mutual insurance through an insurance exchange which has been in existence among ice plants for a number of years in the Central West with a saving of 40 per cent of the board rates. Various other industries have also undertaken mutual insurance very successfully.

The successful insurance exchanges of this kind have usually taken only the better class of risks and have insisted that plant conditions shall be brought up to a fairly high standard before accepting any risk. The old-line companies, on the other hand, have been on the whole less careful as to the risks taken, their general plan of operation having been to charge high premiums on all business and not to trouble themselves much with the kind of risks taken or the difference in risks. In other words, the plan appears to have been to get as much business as possible at a sufficiently high price to cover all losses rather than to discriminate between good and bad risks, the result being that the provident have had to pay the bills of the improvident. Perhaps one reason why mutual insurance companies organized for one specific class of business have succeeded so well is that the working force of such an underwriting organization is able to concentrate its attention on one class of business and to weed out bad practice more effectually than an organization covering all kinds of business. In these days of syndicate operation of a large number of properties it is feasible for companies controlled by one syndicate to carry each other's insurance on a mutual or exchange plan. This, however, is limited to very large organizations. A movement is now on foot in the Mississippi Valley to organize an employers' liability insurance among public-utility companies, and it seems likely that this will be followed by a fire-insurance exchange of the same general character. When organized with a sufficient number of companies and kept in competent and safe hands, insurance of this kind has been very satisfactory.

DEMAND AND DIVERSITY FACTORS.

It is rather remarkable that a subject of such fundamental importance to central stations as demand and diversity factors has received so little attention at meetings of electric-light organizations. The present increasing interest in this subject dates back only to 1909, when Mr. L. A. Ferguson in his presidential address before the American Institute of Electrical Engineers called attention forcibly to its importance, stating in effect that it is the foundation of our systems of centralized supply of electrical energy and the reason for existence of such method of supply. Diversity factor, according to the recently adopted standardization rule of the A. I. E. E., is the ratio of the sum of the maximum power demands of the subdivisions of any

system or part of a system to the maximum demand of the whole system or part of the system under consideration, measured at the point of supply. Demand factor is defined as the ratio of the maximum power demand of any system or part of a system to the total connected load of the system or part of the system under consideration. It is thus seen that diversity factor deals with the maximum demand of a consumer, whereas demand factor deals with his connected load. Both these factors are due to the fact that the maximum demands of all consumers do not come simultaneously. If they did profitable supply of electrical energy from central stations at present prices would be out of the question.

It is the diversity factor plus economies of large power plants as compared to smaller power plants which make economical central-station supply feasible. Central-station distribution system investments are necessarily high, and if it were not for the diversity factor central stations could not compete for many classes of business which they now successfully take away from isolated plants. As central stations reach out more and more for classes of business heretofore untouched a study of demand and diversity factors becomes more important because these factors have so much bearing on the rates which can safely be made. For example, it is of fundamental importance for a central station to know in taking on a certain class of business with 100-kw connected load whether the full 100 kw will be turned on at the time of peak load on the power station or what percentage will be on at that time, and hence what power investment is necessary to serve that business per kilowatt connected. This, however, is only the first step. A more complete study for a given class of consumers includes gathering information on how the maximum demand of certain classes of consumers coincides with that of others on the same feeders or transformers, and hence its effect on the amount of feeder and transformer equipment necessary.

The paper by Mr. C. J. Russell, of Philadelphia, which won the Doherty medal awarded by the National Electric Light Association at its last convention, part of which is printed in this issue, takes up the question of diversity factor and helps explain the importance of this subject to those who have not given the matter much previous thought. A study of demand and diversity factors for different classes of business is difficult because of the fact that all kinds of business are carried on the same feeders by most companies, and there is no method of telling at what time the demands of various customers come, except by placing a recording instrument of some kind on the consumer's service. The most extensive study of this matter has probably been made in Chicago, and the papers presented by Mr. H. B. Gear, of Chicago, before the Western Society of Engineers, and before the Association of Edison Illuminating Companies in 1910, constitute the most important information we have on the actual values to be assigned to the diversity factors of different classes of consumers. The Wisconsin Railroad and Public Service Commission has also done some excellent work investigating this subject and in compiling information from all available sources. The net results of these investigations have appeared in rate decisions which have been rendered by the commission from time to time and reported in these columns.

CAPITALIZING NEW-BUSINESS EXPENSE.

The recent discussions on the "going value" of a public-service property bring forward the question of the capitalization of expense incurred in getting new business. Going value has been recognized in decisions of the Wisconsin commission and by appraisals for rate-making purposes by a number of prominent engineers, and is taken to include expenses incurred other than for plant and equipment in getting a business started and putting it on a paying basis, losses incurred during the first years of operation being included in going value. In other words, going value is usually taken to cover legitimate items of expense in getting the business started which cannot be figured in as part of the tangible physical property of the company. An extension of the principle of going value is toward the inclusion of a certain amount of the expense incurred continuously in securing new business, this to be charged to capital account and not to operation. Electric energy supply companies, for example, have approximately doubled their actual equipment and output every five-year period, taking the country as a whole. A certain portion of this increase, of course, comes to the companies naturally, without effort on their part, but in many cases a considerable portion is the result of work to secure new business. It has been suggested that a fair way to handle this matter would be to charge to "operation" that portion of commercial department expense which is incurred in holding business already obtained and in securing new consumers to compensate for those who drop out. Commercial-department expense over and above this would then be charged to capital account, as an addition to going value, because it is expense incurred in securing business with which to make earnings on additional plant investment. While the separation of these two classes of commercial expense would appear to be a difficult matter, this could be overcome by keeping a record classifying currently the two sorts of expense. The charging to capital account of new business expense of the kind outlined is a matter which deserves attention, as appraisements for rate-making purposes are being made with increasing frequency; and it is to the interest of public-utility companies that their actual investment, tangible and intangible, should be a matter of systematic record.

SHADOWLESS ILLUMINATION.

In an article which was recently published by the London *Electrician*, Mr. H. T. Harrison calls attention to the imperfection of our terminology, and of our notions, concerning illumination. He points out that if a room is lighted in such a manner that there is a complete absence of shadows, as, for instance, in a case of indirect lighting carried to such an extreme that the light is perfectly scattered and uniformly diffused, then there will be great difficulty in perceiving the outlines of bodies. It is

largely by shadows that we are able to detect objects and estimate distances; so that when shadows are destroyed we may have ample illumination for reading purposes, but miserable illumination to see by beyond our books. He thinks that there should be a discrimination against shadowless illuminations, as compared with illuminations that, like coming events, cast their shadows before them. To a great extent Mr. Harrison's contention is justified, although there are limits to the proposition. To many a room without shadows is, like a story without a moral, a thing flat, stale and unprofitable. The eyes are constantly striving to assign distances to objects by binocular muscular adjustments, to replace the absent information carried by shadow, and they tend to become unduly fatigued. Besides, the esthetic effect of perfectly shadowless illumination is very depressing. The sun is a magnificent dispenser of shadows, and scatters them over the landscape with lavish hand. We are so accustomed to the coexistence and blending of light and shade that an artificial world of shadowless illumination leaves us, like fish out of water, stranded on the rocky shore of discontent.

Nevertheless, we think it is possible to go to the other extreme and have contrasts of light and shade too powerful for peace of sight. When a naked arc lamp lights up a room with poorly reflecting walls and ceiling, the shadows look like the darkness of the Egyptian plague—a darkness that could be felt. A due medium in light and shade is the most pleasing to mind and eye. It should neither be shadowless nor all light or all shadow. There should be intermediate blends of shadow tones, where light forgets itself in shade and shadows dance with lights. Mr. Harrison seeks a numerical criterion and gradation of illumination, in regard to its shadefulness. This should not be difficult.

If we select any point in a room, or lighted space, we can always insert an opaque card at this point, and measure, or assume as measured, the illumination on this card as we turn it round in different directions. The ratio of the minimum to the maximum illumination throughout the process might be called the chiaroscuro ratio of the illumination at that point; or, if objection is taken to the Italian phrase, it might be called the light-shade ratio. If we wish to confine our measurements to the horizontal plane through the point, then the card should be considered as a vertical photometer screen, and rotated about a vertical axis so as to face all points of the compass successively. The ratio of the minimum to the maximum illumination in the rotation would then be the horizontal chiaroscuro ratio of illumination. In a shadowless room with uniformly scattered lighting this ratio might approach unity, since the card would be nearly equally well illuminated at all points of the compass. In the opposite extreme of a room all light or shadow the ratio might approach zero. In a pleasingly lighted room it might be, say, 0.2 to 0.3. If the measurement were made in a selected vertical plane, instead of in the horizontal plane through the point, the ratio would be the chiaroscuro ratio of illumination in that vertical plane. Finally, if the greatest range of illumination at the point were sought, regardless of the plane in which the card turned, the ratio might be taken of the minimum to the maximum illumination at the point, with the card set by trial to the proper angles. This ratio might be called the spherical chiaroscuro ratio of illumination at the point. As a rule, illuminating engineers are content to specify a certain amount of illumination at given areas in a room, and to leave the shadows to good taste; but the chiaroscuro ratio might occasionally be of service, if only in order to define ideas.

THE PHYSIOLOGICAL EFFECTS OF THE MERCURY ARC.

The article by Dr. Charles H. Williams in the current issue is of importance as summarizing the results of thorough ophthalmological examination of a considerable group of persons who have regularly and for long periods worked by the light of the mercury arc. There has been more or less dispute as to whether this particular light produces any observable effect on the vision of those habitually using it. It is probable that where belief has existed as to the injurious nature of the light, this has been due to prejudice against its peculiar quality rather than to any actual observation of ill effect. In a case where about four years ago the mercury-vapor tube was adopted by a large printing office the men employed were at first inclined to criticise the light, but after a short experience all favored it strongly, some even going so far as to claim for it a curative effect on weak eyes. The results of Dr. Williams' investigation confirm this experience of a large number of men extending over four years, though he observed a certain amount of temporary color fatigue, which, however, is inevitable in the regular use of any strongly colored illuminant. As regards other effects on vision, in which his results are completely negative, the clinical records for this group of twenty-eight persons show certainly quite as good conditions as would be expected in any other group of similar size working much by artificial light. There is always opportunity for eye strain owing to glare from misplaced lamps in the use of artificial light, and probably the mercury arc is not exempt from this difficulty. Certainly if it were at all more likely to produce eye strain than other lamps, some evidence of the fact should have been observable in the careful examination of this number of cases, whereas no evidence of it appears.

The color fatigue observed was of a particularly interesting character from a theoretical standpoint, although practically of small account from its evidently temporary character. The strongest lines in the spectrum of the mercury arc, to which at least nine-tenths of the visible light is due, lie close to the point at which the red and green sensations, as given in the curves of Koenig and others, overlap with nearly equal ordinates, and hence both these sensations are subject to fatigue in somewhat nearly equal degree. It therefore appeared, in general, in Dr. Williams' color sense tests, that there was comparatively little confusion of red and green. On the other hand, the fatigue of the green sensation showed rather plainly at the contact of the blue and green owing to the greater fatigue of the latter sensation. Even this did not appear in the group of draftsmen investigated who used the light only a portion of the time, and it seemed to disappear in the other cases after a few hours' rest. This is quite in accordance

with the results of Burch, who was able to produce all kinds of temporary color fatigue by suitable exposure to colored light, which, while temporarily complete, disappeared after the eye had opportunity for rest. It would be interesting to follow out the matter of color fatigue in using other artificial illuminants. The yellow flame arc might be expected to give results not very different from those here recorded, while in the case of ordinary flame illuminants and incandescent lamps some red-green fatigue should still be evident owing to the predominance of these colors. As regards other ophthalmological matters, Dr. Williams' results are about what might be expected. At all events, it is gratifying to have these thoroughly negative results recorded, and we are inclined to the opinion that similarly negative results will be found in general for workers under artificial light, assuming that it is intelligently installed. It is improper use, rather than much use, of artificial light which is chargeable with eye strain, and when eye strain exists it can generally be remedied by intelligent rearrangement of the illuminants.

ELECTRIC LINE OSCILLATIONS.

It is a general property of electric lines to oscillate when electrically disturbed, which property has both advantages and disadvantages. The advantage is developed in connection with wireless telegraphy, where a line is mounted vertically and very powerfully disturbed by high-tension charges and discharges. The electromagnetic oscillations excited in the wire under the influence of the wire's reactance overleap their boundaries and spread out as electromagnetic waves, radiating over the surface of the globe. The disadvantage is often developed incidentally and accidentally by a short-circuit or other powerful disturbance in a transmission system, which may set up oscillations of great and destructive amplitude in the potential and current on the system. At first the men accustomed to operate energy-transmission systems were inclined to discredit the latent possibilities for injury in the oscillations of their lines. Their prevous experience had been derived with lower-tension systems of relatively small power delivery. Their more recent experience with systems of increased area, voltage and power did not at first rouse their fears so long as no accident occurred, although the designing engineers had some misgivings. Time, carrying unfortunate opportunity on his shoulders, brought to the central-station operators a realization of the latent disadvantages in electric oscillations through break-downs in lines and apparatus.

A capital research on the electric oscillations set up in a long-distance energy-transmission system by switching has been presented by Mr. G. Faccioli in a paper read before the American Institute of Electrical Engineers at the recent Chicago convention. The lines on which the research was conducted were those of the Great Western Power Company, 154 miles (244 km) in length, running from Big Bend to Oakland, Cal., via Sacramento. They are operated at about 100 kv between conductors and can readily carry 10,000 kw per wire. They are operated at a frequency of 60 cycles per second, and have, of course, transformers at the generating and receiving ends. In the simplest case any such line must have four sets of oil switches, two sets at each end—one for the high-tension and the other for the low-tension sides of the transformers.

When voltage is thrown on or off such a line the conditions are very varied, depending on the load, the phase of the cycle at which the operation happens to commence, the time-interval between the actions of the three blades of the operated switch and the location in the system of the particular switch operated. The oscillograph records have, therefore, to wrestle with a good deal of variety and complexity of detail on these accounts. Nevertheless, the paper tends to show that the largest overvoltage oscillation on the line at no-load set up by switching operations of various kinds, both opening and closing, was only 60 per cent of that normally impressed. Consequently, if a system is operated at 100 kv, the maximum voltage that can momentarily be set up by light-load switching as measured through transformers would only be 160 kv and ordinarily less. The above result is in conformity with the existing theory of the subject, which indicates that when an unloaded line is switched on or off the maximum overvoltage to be expected is less than 100 per cent unless the line is resonant to the impressed frequency, when on switching there may, under particularly favorable conditions, be generated a considerably higher voltage at the distant end, not merely momentarily, but also permanently. Even in such resonant cases, however, a small amount of load should be sufficient to destroy the overvoltage.

The paper contributes much valuable engineering information and is unusually definite in its details. Incidentally many conditions are brought to light which are unusual to short-distance transmisssion. For instance, it is mentioned that when the unloaded generator is excited to less than half terminal voltage the mere act of connecting it to the unloaded transmission lines doubles that terminal voltage, owing to the magnetizing effect of the leading current that charges the line—a current which at rated voltage is about 50 amp per wire, representing a reactive power of some 3 megawatts per wire at an extremely low power-factor. This idle current is nearly as strong as the current delivered when the generator is under rated load, so that with a single generator supplying the line throwing the entire load off and on makes but little difference to the current strength, but a large difference in the power-factor. An appendix to the paper by Mr. W. W. Lewis describes the technique that is required in operating an oscillograph under such conditions. In the ordinary instrument the film covers only a small fraction of a second, namely, one-tenth to one-thirtieth second, according to the driving speed. This duration of exposure may be all that is desired in a laboratory experiment when the operator closes a switch, which not only initiates the phenomenon, but also releases the oscillograph shutter. When the switch is released by a distant operator, 250 km away, there is naturally some little difficulty in releasing the shutter at the right instant to catch the record of his performance. Specially long films were used, and a chain of four assistants was made, a telephone line being used as one of the links.

Fall Convention of New England N. E. L. A. Section.

The third fall convention of the New England Section of the National Electric Light Association will be held at The Mount Washington, Bretton Woods, N. H., Wednesday, Sept. 27, to Friday, Sept. 29, inclusive. The tentative program calls for a reception and dance on the evening of the 27th; a business session in the forenoon of Thursday, the 28th, the afternoon being devoted to the entertainment of the ladies, and a banquet in the evening; another business session on the morning of Friday, the 29th. The convention will close probably in the latter part of the afternoon of that day, leaving the week-end for those who desire to take further trips through the mountains. A large attendance is anticipated.

Convention of the Association of Edison Illuminating Companies.

The thirty-second annual convention of the Association of Edison Illuminating Companies will take place at Spring Lake Beach, N. J., Sept. 19, 20 and 21. Provision has been made for an opening reception and dance on the evening of Sept. 18 and for a fishing excursion on Barnegat Bay on Sept. 22 in addition to the entertainment features provided during the three days of the convention proper. The list of papers is not yet available, but reports will be presented on the following topics: Incandescent lamps, meters, National Electrical Code, electric heating, steam turbines, electric vehicles, high-potential disturbances and electric storage bateries. Morning sessions will prevail with the exception of Tuesday, when an afternoon session will be held as well, the other afternoons being devoted to golf, automobile trips, etc. On Thursday evening a session will be held in conjunction with the formal closing of the convention. During the forenoons while the convention is in session the ladies will engage in a croquet tournament, tennis tournament, putting contest and other special entertainments provided for them.

Railway Electrical Engineers' Convention.

Arrangements for the annual convention of the Association of Railway Electrical Engineers, to be held in Chicago at the Hotel La Salle Nov. 6 to 10, are being made by the committees of the Association of Railway Electric Supply Manufacturers. The latter association is composed of some sixty companies manufacturing electrical supplies for use on railways. Membership in this association is prerequisite to the reservation of exhibit space at the convention. The grand ballroom on the nineteenth floor of the La Salle has been reserved for manufacturers' exhibits, twenty-nine booths ranging in size from 70 sq. ft. to 182 sq. ft. being provided. Further information in regard to exhibits may be obtained from Mr. W. E. Ballatine, 436 South Dearborn Street, Chicago.

Chicago Elevated Railways Merged by Central-Station Finance.

Following the plan of elevated-railway reorganization in Chicago under the leadership of Mr. Samuel Insull and his associates in the Commonwealth Edison Company, the old board of directors of the South Side Elevated Railroad Company has resigned and a new board has been elected. This consists of Messrs. Samuel Insull, Henry A. Blair, B. I. Budd, Ira M. Cobe, William A. Fox and J. H. Gulick. Mr. Insull, who is president of the Commonwealth Edison Company, was elected chairman of the board. Mr. Budd was elected president of the South Side road, succeeding Mr. Charles V. Weston, resigned. Mr. Budd is also president of the Metropolitan West Side elevated road and has been or will be elected president of the Northwestern and Chicago & Oak Park lines, these four roads being combined in the Chicago Elevated Railways, of which Mr. Insull is chairman of the executive committee. Mr. Blair is the promoter of record of the elevated merger and Mr. Cobe is a financier who has been associated with Messrs. Insull and Blair in the deal. Mr. Fox is treasurer and Mr. Gulick is auditor of the Commonwealth company.

By this merger, to which the Commonwealth Edison Company was a party, that company will eventually increase its already large railway load greatly. It is said that the railway business of the elevated and surface railways of Chicago is worth $6,000,000 a year to the central-station company, and it is highly probable that all of this business will go, sooner or later, to the Commonwealth company, for it is likely that the surface and elevated roads will be combined before long. After that it is not impossible that the Commonwealth Edison Company and the Chicago railways may be merged in one great corporation supplying the electric-service and electric-railway needs of Chicago. At present, however, the Commonwealth Edison Company and the men associated with it are the dominant figures in the elevated-railway situation in Chicago.

Telephone Pioneers of America.

The Telephone Pioneers of America, a recently organized body, will hold its first meeting at Boston Nov. 2, 3 and 4, at which President Theodore N. Vail, Prof. Alexander Graham Bell and other prominent figures in the telephone field will be present. The committee in charge consists of Messrs. Henry W. Pope, Charles R. Truex and Thomas B. Doolittle, of 15 Dey Street, New York, from whom further information may be obtained.

The association has issued in neat pamphlet form memorial notices, accompanied by a portrait, of the late William Dunlap Sergent, for many years vice-president and general manager of the New York & New Jersey Telephone Company; William N. Estabrook, recently vice-president and general manager of the New York & Pennsylvania Telephone & Telegraph Company, and Frederick Allen, night chief operator in the New Haven exchange of the Southern New England Telephone & Telegraph Company.

Deerfield River (Mass.) Hydroelectric Development.

The New England Power Company has entered upon its large undertaking of developing the hydroelectric power resources of the Deerfield River in Massachusetts and Vermont. The work involves the construction of four dams in the Deerfield River at or near Shelburne Falls, Mass., with falls of 45 ft., 70 ft., 65 ft. and 65 ft. respectively. A storage reservoir will be built at Searsburg, Vt., with a capacity of 2,500,000,000 cu. ft. It is estimated that the energy developed will be about 70,000,000 kw-hours per year. Each of the four stations to be erected at the dams will have three generating units of about 2000 kw at 2500 kw capacity. There will be horizontal waterwheel turbines.

A transmission line will connect the Vernon (Vt.) plant, now operated by the Connecticut River Power Company, with the new plant. A large part of the energy generated on the Deerfield River will be bought and distributed by the Connecticut River Transmission Company, of Boston. A contract has already been made to furnish the Boston & Maine Railroad Company with a large block of the energy for its use in operating trains in the Hoosac Tunnel, which was lately electrified. All the new plants, together with

the Vernon (Vt.) plant and the new plant built by the State of Massachusetts at its Wachusett reservoir dam in Clinton, Mass., will be run in multiple.

The engineering and construction is being done by the Power Construction Company, of Boston, with local headquarters at Shelburne Falls, Mass. The property was acquired and the power company organized by Messrs. Chace & Harriman, 50 Congress Street, Boston, who organized the Connecticut River undertaking about two years ago, which has proved very successful.

Operation of Consolidated Properties in Ontario, Canada.

An account was published in these columns Jan. 12 of the consolidation of a number of electrical properties in the Province of Ontario, Canada, by Messrs. Smith, Kerry & Chace, engineers, of Toronto. The holding company is known as the Electric Power Company, Ltd., and the companies controlled operate in that portion of the Province of Ontario lying east of Toronto, west of Kingston and north of Lake Ontario. This district embraces practically all of that section of Ontario not now supplied by lines of the Hydroelectric Commission, which has thus far confined its operations chiefly to the western section of the province.

The Electric Power Company controls a number of water-powers along the route of the Trent Valley Canal, from Burleigh Falls to Trenton. The district served covers an area of approximately 5000 sq. miles, and has a population of about 250,000. In this district are such cities and towns as Peterborough, Kingston, Belleville, Oshawa, Lindsay, Cobourg, Port Hope, Bowmanville, Trenton, Campbellford, Napanee, Deseronto, Madoc and Picton. Hydroelectrical energy is being delivered at present from five points to a number of substations at a pressure of 44,000 volts. Of the substations erected subsequent to the consolidation of the properties those at Brighton, Colborne, Cobourg and Port Hope are now in operation. The Oshawa, Deseronto, Newcastle and Bowmanville substations are expected to be placed in operation during September. The generating and transforming station of the Sydney Electric Power Company, on the Trent River, just north of Trention, it is expected, will be placed in operation during September. This will provide an additional 4000 hp and enable the various substations to carry additional load. The present generating stations at Campbellford have a rating of over 5000 hp and have been running for some time with a daily load-factor of from 80 per cent to 90 per cent.

An interesting feature of the work of the Electric Power Company is the unification of the systems so as to have a standard frequency, phase and voltage for the various cities, town and villages of eastern Ontario, and in addition the substitution of a twenty-four-hour service for the "dusk-to-dawn" service.

The substation at Cobourg, which is typical of all the others, is designed to contain three 750-kva, oil-insulated, water-cooled, three-phase transformers for stepping down the potential from 44,000 volts to 2400 volts. Two of these transformers have already been installed and have been in operation now for some weeks. The entire load of the Cobourg Utilities Company has been transferred to the new substation, and coincident with this transfer has been the change from 125-cycle, 1100-volt, single-phase service to 60-cycle, 2400-volt, three-phase service. There were between 90 and 100 service transformers on the old distribution lines, and about a dozen of these could not be used in connection with the new system as they were wound for 1100 volts only. The remainder were reconnected for 2200 volts and practically all of them operated satisfactorily at the higher voltage and lower frequency. The thirty-five-light, constant-current transformer for the arc-lamp circuits is now being rewound for 60 cycles by the Canadian General Electric Company, the street-lighting system at present being supplied with energy from a 60-cycle transformer loaned by the manufacturing company while the old transformer is being rewound.

The change over of both the street-lighting and commercial circuits was made with practically no interruption of service. The Cobourg Utilities Company, in addition to furnishing electric light and gas, also furnishes the water supply to Cobourg, and as soon as a new motor-driven pump has been installed, which will be in the course of a few weeks, the old steam plant will be entirely shut down.

Prize for Electric Lamps for Miners.

A statement has been issued by the United States Bureau of Mines and also by the British ambassador in Washington regarding the conditions of entry for a competition to be conducted by the British government for obtaining a safe and efficient type of electric lamp for miners. The prize offered is £1,000, to be awarded on the recommendation of Mr. Charles Rhodes, a former president of the Institute of Mining Engineers, and Mr. Charles H. Merz, a member of the departmental committee on the use of electricity in mines. The competition will be open to persons of any nationality. Lamps must be addressed care of C. Rhodes, Esq., at the Home Office testing station, Rotherham, England, and must reach the testing station not later than Dec. 31, 1911. A spare globe should accompany each lamp.

The requirements which should be fulfilled by any lamps submitted for competition are as follows:

The lamp should be of sound mechanical construction, so as to withstand rough usage; should be of simple construction and easy to maintain in good order and repair; so constructed as to render impossible the ignition of inflammable gas either within or without the lamp, and should be effectively locked so that it cannot be opened without detection. The lamp battery should be so constructed that any liquid which it may contain cannot be spilled when the lamp is in use and means should be provided for dealing with any gas which may be generated by the battery. The materials used and the construction should be such that metals and other parts will not be liable to deterioration by corrosion as a result of the action of the electrolyte, etc., used in the battery. The lamp should be capable of giving an amount of light not less than 2 cp continuously for a period of not less than ten hours. The light should be well distributed outside the lamp. A movable reflector to concentrate or to shield the light may be provided.

In addition to the above requirements, regard will be paid to (*a*) the first cost of the lamp; (*b*) the cost of maintenance; (*c*) convenience in handling, and (*d*) the weight of the lamp when charged and ready for use.

Electrical Code of the City of New York.

The Bureau of Electrical Inspection, Park Row Building, New York, is distributing the 1911 edition of the electrical code of the city of New York, which represents the work of the engineers of the Department of Water Supply, Gas and Electricity and those of the New York Board of Fire Underwriters, extending over a period of years, in producing a set of electrical inspection requirements which, while based on the National Electrical Code, are adapted for use in New York City. Such departures from the standards of the National Electrical Code as have been made necessary by local laws or conditions are indicated

in the edition by bracketing the portion omitted and inserting immediately after it in italics the substitute requirement of the city, if any exists. The rules relating to wiring in marine work, which is under federal and not municipal jurisdiction, are omitted from the New York edition. The National Electrical Code has been adopted almost in its entirety by the commissioner of water supply, gas and electricity. The rules on constant-potential pole lines over 5000 volts are displaced by the general city rules on pole lines, and the rules for constant-current systems for concealed knob and tube work and for transformers in buildings on low-potential systems are eliminated entirely, none of these constructions or systems being permitted in the city. A complete set of regulations governing garages is added, and there are slight modifications to some of the rules. The edition embraces all the revisions made by the Underwriters at their recent biennial meeting in New York City. Criticism of the new rules is invited, and for this purpose copies may be obtained from the Bureau of Electrical Inspection.

Indiana Electric Light Association Meeting.

With a final registration of about 120 members and associates, the three-year-old Indiana Electric Light Association held the largest and most successful meeting of its existence at South Bend, Ind., Aug. 23 and 24. President F. A. Bryan, of South Bend, opened the first session at the Oliver Hotel on Wednesday morning, welcoming the delegates to the city in his official address. He referred further to the close interrelation and co-operation that should connect the interests of central-station men, manufacturers, contractors and jobbers, and among the tendencies of the day noted the increasing value placed upon the commercial side of central-station work, as evidenced by the discussions at recent conventions. The public must be educated, declared President Bryan, to a proper realization of the burdens of corporation affairs, the increasing expenses of plant operation and the cheapness and convenience of the electric service supplied by the corporations. One of the good uses of a public-utility commission, he added, is to convince the public of the real facts of the utility business. Corporation regulation is soon to be expected in Indiana, and such a commission, when appointed, urged the speaker, should be selected from among the very ablest men. A good utility law should have the result of stopping the abuses of competition and financiering. The interests of the public and the companies are identical, but if the latter are subjected to ruinous competition or unfair reduction of rates, service is sure to suffer. While electricity has already done much, said President Bryan in closing, in the future it may be expected to go still further toward saving labor and rendering cities smokeless.

The report by Secretary-Treasurer J. V. Zartman, of Indianapolis, showed a total membership of sixty-five central stations in the association, in addition to twenty-five associate members among manufacturers and sales representatives.

Mr. John C. Hornung, of the W. H. Schott Company, Chicago, then opened the program with his paper on "Heating in Connection with Central-Station Work." After pointing out the magnitude of the heat quantities which are lost in the exhaust of the purely electrical generating plant the author submitted practical data showing the heating service which may be expected in connection with typical engine-driven plants. Mr. Hornung's paper was discussed by President Bryan and Messrs. R. A. MacGregor, of Connersville, and W. J. Kyle, Chicago.

MOTOR SERVICE.

Mr. MacGregor then presented his paper on "Power," in which he protested against the tendency to make very low rates to gain motor-service business, when such business may be unprofitable. The speaker charged some motor salesmen with urging rate reductions in order to secure the sale of their motors. In such cases, he said, a few motors are sold to the utter demoralization of rates within the town. In some instances, even dental motors and 16-in. fans have been accorded a "power" rate, said the speaker. While electric drive has a great many well-known advantages and conveniences, he continued, the practical central-station salesman realizes very well that where an isolated plant has already been installed no other argument than the potent one of a saving in cost will effect the replacement of the private plant. But the rates quoted under any conditions should be such as to insure profit to both the customer and the company. Mr. MacGregor also pointed out that sometimes, through the purchase of a number of smaller individual motors at a higher cost than a single large group-drive motor, the customer may have a higher rate and yet save money where his load is intermittent and diversified. In Indiana, he said, some manufacturers have gained the idea that a 2-cent rate is a fair "power" price, and demand this rate without investigating their own costs. Others cite the low rates given by municipal plants in nearby towns to political favorites. The manufacturer who is a prospective central-station customer should be shown the high cost of isolated-plant service, concluded Mr. MacGregor, and in this connection the plant fireman can usually provide some valuable information.

The paper was discussed by President Bryan, Messrs. W. J. Kyle, Chicago, and W. D. Ray, of Hammond. President Bryan said that many rates have been established too low and are in need of revision. Mr. Kyle showed how it has been possible to employ a higher rate and yet save the customer money by installing a number of individual motors in place of a single large motor which would be required to run continuously. Mr. Ray objected to the author's references to the central station's relation with manufacturers in soliciting motor business, and declared that the manufacturers can give special and most valuable assistance. In his own experience, said Mr. Ray, he had never found rates to be driven down by motor salesmen.

RURAL ELECTRICAL SERVICE.

An afternoon session was held on Wednesday in the ballroom of the Edgewater Club at St. Joseph, Mich., where the party was taken by special electric interurban cars. Mr. C. E. Layton, of Lebanon, read his paper on rural electrical service. The value of mechanical power on the farm, he said, is now being appreciated, and many transmission lines have been built out into farming districts, at the cost of the customers, who find electric motors cheaper than gas engines. In one case Mr. Layton's company ran a line of this kind, the farmers furnishing the wire and the company the poles and transformers, but, as many of these customers use only the minimum amounts of energy, the service has not paid. Motors for pumping cost one-tenth as much as the price of windmills and they provide good central-station business. The conveyor type of ensilage elevator is found much more economical than the very large motor-driven blowers required for the same duty.

In conclusion Mr. Layton pointed out that, freed of distribution costs where the farmer pays for the line extensions, rural service may be profitable business. For the future this offers a large field for development, because 70 per cent of the country's population lives in country communities and if the central stations could acquire even one-tenth of the business their output would be increased 25 per cent. In a discussion of the subject of distributing voltages which followed the presentation of Mr. Layton's paper, Mr. H. C. Sterling, of Three Rivers, Mich., told of his use of small transformers stepping down the emf directly from his transmission pressure of 11,000 volts to the customer's service. Others taking part in the discus-

sion were Messrs. F. A. Bryan, South Bend; T. C. Palmer, Kokomo; N. M. Argabrite, Muncie; J. W. Robb, Clinton; C. L. Harting, Elwood, and W. D. Ray, Hammond. While farm service, said Mr. Ray, seems hardly profitable now, it may be possible of development, as in the case of the electric interurban railway. In general, he added, extensions when prudently planned have always proved profitable.

"Economies of Operation Secured by Consolidation of Small Properties" was the title of a paper by Mr. L. B. Andrus, general superintendent of the Indiana & Michigan Electric Company, read in the author's absence by Secretary Zartman. Mr. Andrus submitted an exhaustive study of the causes that contribute to improved administrative or "man-power" effectiveness and increased technical efficiency as the result of grouping isolated properties into a system. The numerous factors in this result were enumerated with careful detail.

BUSINESS SESSION.

At the business session of Thursday morning Mr. C. C. Perry, of Indianapolis, called attention to the impending commission-law agitation in Indiana and suggested that for protection of the central-station interests, as well as those of the public, through the construction of a fairly drawn bill, the Governor of the State be petitioned to appoint a commission to study utility regulation measures. Mr. J. B. Robb, of Clinton, also urged repeal of the State law which requires competitive bids when awarding street-lighting contracts in Indiana towns of less than 10,000. As Mr. Robb pointed out, such communities cannot support more than one lighting company, and the requirement of competitive bids brings bidders into the field having no serious intention of supplying service but expecting only to be bought out. On motion of Mr. MacGregor these subjects were referred to the advisory committee.

Mr. John F. Gilchrist, of Chicago, president of the National Electric Light Association, then addressed the Indiana men on the subject of the aims of the national body and the benefits Indiana members might receive through amalgamation with the larger body. Mr. Gilchrist referred to the interest stimulated among corporation employees who become members of the N. E. L. A., and showed how, as the result of the Indiana association becoming a state section, its local character and self-government would be retained, while it would receive the benefit of the valuable work and printed matter of the larger body.

STEAM TURBINES.

Mr. E. D. Dreyfus, commercial engineer for the Westinghouse Machine Company, Pittsburgh, Pa., read a paper on "The Steam Turbine for Future Work," in the course of which he discussed diversified services, mechanical construction, inherent characteristics, accessibility, exterior design, efficiencies and ratings. In general, he said, there are now 20,000,000 hp of steam turbines in use, and machines are available ranging in rating from a fraction of a horse-power up to 30,000 kw. The turbine has met many broad requirements in its applications, and is not encumbered as the steam engine is restricted. For example, said the speaker, great vessels like the *Mauretania* and *Lusitania* would be impossible without turbine drive. Mr. Dreyfus defined the reaction and impulse types of turbines and explained that, while both actions occur in all commercial turbines, one or the other predominates and gives its name to the type. Complete-expansion and low-pressure turbines were described, and the new "bleeder" type of turbine for steam-heating service was illustrated by lantern slides.

The author deplored the confusion resulting from the two systems of turbine ratings, one using a maximum continuous basis, while the other considers a conservative normal rating with allowance for 25 per cent overload. Mr. Dreyfus also spoke of the liberal guarantees sometimes made on turbine efficiencies, sometimes efficiencies higher than the theoretical possible limits being solemnly included in the specifications. The paper was concluded with some further pointed suggestions to persons interested in turbine equipment. To give close regulation such machines should have quick-operating governors, the simplest possible construction being desirable. After pointing out the dangers of unbalancing where disk construction is used, the point was made that with the multitude of small blades in the Parsons type the loss of a number may be suffered without seriously affecting the operation of the unit. In reaction turbines, the speaker added, the low relative pressures and velocities across the blades act to decrease wear. The design of turbines, he continued, should be such that all parts are readily accessible for inspection while a good arrangement of the piping and auxiliary equipment is secured. The reading of the paper was followed by an exhibition of lantern slides.

At the afternoon session Mr. G. R. Parker, of the General Electric Company, Schenectady, N. Y., followed with

President-Elect F. A. Bryan.

an illustrated talk on Curtis steam-turbine installations. Beginning with Hero's classical experiment Mr. Parker traced turbine development down through modern large units. Bucket wear, he said, is due chiefly to local conditions. Erosion sometimes occurs, caused by water coming over in the steam, but is rare where superheated steam is used. A number of illustrations were then thrown on the screen to show that such wear is negligible even after years of service. Originally low-pressure turbines were expected to be used with non-condensing engines, but most of the turbine units are now in service with engines formerly run condensing. The interesting exhaust-steam turbine application in the power house of the New York subway was cited by Mr. Parker, who said that, without increase in boilers, buildings or real estate, the rating of this station has been more than doubled with an accompanying reduction of 25 per cent in the specific coal consumption. While the engine efficiency has been lowered as the result of overrating them, the efficiency of the turbines is so high as to maintain the combined figure practically constant at all loads. In the new mixed-pressure turbines recently brought out automatic valves are provided by which the unit takes live steam when sufficient low-pressure steam is not available. Separate sets of high-pressure and low-pressure nozzles are provided, so that the turbine works at very high efficiencies under either condition of operation. A brief discussion of the turbine papers was entered into by Messrs. F. A. Bryan, T. C. Palmer, G. R. Parker and E. D. Dreyfus.

ELECTION OF OFFICERS.

For the ensuing year the Indiana Electric Light Association unanimously elected officers as follows, President Bryan being retained at the head of the organization for another year:

President—Mr. F. A. Bryan, South Bend.
Vice-president—Mr. Felix L. Cadou, Vincennes.
Secretary-treasurer—Mr. J. V. Zartman, Indianapolis.

Executive Committee—Messrs. R. A. MacGregor, chairman, Connersville; E. Darrow, Indianapolis; W. D. Ray, Hammond; Thomas Donohue, Lafayette.

Advisory Committee—Messrs. C. C. Perry, Indianapolis; T. C. McReynolds, Kokomo; J. W. Robb, Clinton.

Finance Committee—Messrs. C. Blank, Martinsville; J. W. Moncrieff, Bloomington; Thomas A. Grist, Knox.

Mr. F. A. Bryan, who was re-elected president of the association, is general manager of the Indiana & Michigan Electric Company, operating steam and water-power plants at South Bend, Elkhart and Mishawaka, Ind., and Berrien Springs and Buchanan, Mich., and lighting the cities of Elkhart, South Bend, Mishawaka, Buchanan, Berrien Springs, St. Joseph and Benton Harbor. Mr. Bryan has been located at South Bend for the past eleven years, during which period a series of combinations of the old South Bend Electric Company with the Elkhart Electric Company, the C. A. Chapin Light & Power Company, of Buchanan, and the Berrien Springs Power & Electric Company has resulted in the formation of the present system with its chain of water-power and steam plants connected by high-tension transmission lines. Mr. Bryan was graduated from the Pennsylvania State College with the civil-engineering class of 1890 and served for a time with the old Edison General Electric Company, in 1893 going with the H. Ward Leonard Company. For six years before coming to South Bend he was engaged in civil-engineering work for the Michigan Central Railroad.

ENTERTAINMENT.

Following the session of Wednesday morning the members of the convention were taken by special cars of the Southern Michigan electric railway to the Berrien Springs water-power plant of the Indiana & Michigan Electric Company, where a picnic luncheon was served. After inspecting the plant the journey was resumed to St. Joseph, Mich., where the afternoon and evening were spent at the Edgewater Club. The special cars returned the party to South Bend late in the evening.

Texas and Electrical Corporations.

Attorney General J. P. Lightfoot of Texas has submitted to the Legislature a lengthy report on his investigation of the alleged electrical trusts said to be operating in Texas. Referring to electric light and traction properties, the report states that "the Texas companies which are operated by Stone & Webster, of Boston, Mass., are as follows: The Dallas Electric Light & Power Company, Dallas Consolidated Electric Street Railway Company, Rapid Transit Railway Company and the Metropolitan Street Railway Company, which are all owned by the Dallas corporation. In El Paso the El Paso Electric Railway Company and the Juarez Traction Company are owned by the El Paso Electric Company. The Galveston-Houston Electric Company owns the controlling interest in the Galveston Electric Company, the Houston Electric Company, the Galveston-Houston Electric Railway Company, and also owns stock in the Suburban Realty Company and the Hotel Galvez at Galveston. The Northern Texas Electric Company owns a controlling interest in the Northern Texas Traction Company, the Dallas & Oak Cliff Electric Railway Company and the Ft. Worth Southern Traction Company.

"It will thus be seen that the several street-railway systems of Dallas, Ft. Worth, Galveston, Houston and El Paso are all owned by a holding corporation, which in turn is owned, controlled or managed by the Stone & Webster Management Association, which is a corporation organized by the partnership of Stone & Webster. All the above corporations are under the management and control of one corporation, through which the electrical supplies and appliances are purchased, principally from the General Electric Company.

"The four electric-railway companies of Dallas are owned by one corporation, the two lines of El Paso by another, the street-railway systems of Galveston and Houston by a third corporation; the Northern Texas Traction Company and the Ft. Worth Southern Traction Company are owned by a fourth corporation. Each of the four corporations is owned and managed by the Stone & Webster Management Association, another corporation. Some of the stock and bonds of all these Texas companies are owned by electric securities companies, which, in turn, are partly owned or controlled by the General Electric Company.

"The Southwestern Telegraph & Telephone Company is owned by the American Telephone & Telegraph Company, known as the Bell system. The Western Union Telegraph Company is also controlled by the American Telephone & Telegraph Company. The Postal Telegraph Company of Texas was until recently owned by the American Telephone & Telegraph Company.

"It will, therefore, be seen that the lines for telegraphic and telephonic communication in Texas are largely owned and controlled by the Bell system, while the electric street railways find control and domination finally lodged in Stone & Webster and the General Electric Company through subsidiaries.

"We also find that the General Electric Company, the American Telephone & Telegraph Company and the Western Union are strongly tied together through common directors and common stockholders. Each and all of these concerns, that is to say, the American Telephone & Telegraph Company, the Western Union and the General Electric Company and all underlying corporations, are dominated by a group of bankers in New York and Boston, chief among whom may be mentioned the firm of J. Pierpont Morgan & Company, Kidder, Peabody & Company, Lee, Higginson & Company and several other banks and trust companies."

General Lightfoot discusses water-power concentration and deprecates what he declares to be the evident intention of great corporations to get all this in their own hands and under their domination. Much of the report enters into details affecting the ownership of stock of the various electrical corporations doing business in Texas, the conclusion being that nearly all of them are dominated by the Bell Telephone Company, the General Electric Company and a few others, or, at least, controlled by men who control these companies. The conclusions of the Attorney General's report are as follows:

"The resolution under the authority of which I have acted made it necessary to examine into the relations of the corporations not only from a legal standpoint, but also in the light of the effect of such concentration upon the industrial and economic welfare of the State and nation. Many of the facts which have been set forth are valuable only for the light which they may throw on the great economic questions involved. It would be difficult for street railways and electric-light plants in widely separated cities to enter into competition. Moreover, a great many of these concerns have no permit to do business in Texas, and if the facts set forth show any violation of the law by them it would be rather a violation of the laws of other states or of the federal government. The State courts have no jurisdiction to punish offenses which alone affect interstate or international commerce.

"There are also serious legal difficulties involved touching the power of the State to control the actions of corporations which manufacture and deal in patented devices, as it is claimed that the patent rights carry with them certain exclusive privileges and monopolies granted by the federal government. These contentions find some support

in the federal decisions, but the question has never been definitely and satisfactorily adjudicated by the Supreme Court of the United States.

"While all the facts tend to show a movement toward concentration which will, if persisted in, wield a potent influence over the industrial welfare of the nation, the State is very much handicapped by reason of the limitations of its powers and the law to deal with a subject which is international in its scope and effect.

"The operation in Texas by the Stone & Webster syndicate presents several interesting questions for determination. Their movements have always been predicated upon the most eminent legal advice to be had. So far as I have been able to determine the fact, it appears that the city charters of the various cities in which they operate the local street-railway systems confer upon the several city governments a wide control over the matter of franchises, the fares to be charged, the character of the equipment, the service to be rendered the public, the hours of labor for the employees and other pertinent and salient matters which might bring such cases within the reasoning of the decision by the Supreme Court of this State in the case of State against Shippers' Compress Company, 95 Texas, 613, in which the court held that under the facts in that case there was no unreasonable restriction of competition between several of the compress companies which were owned by the same corporation. The Railroad Commission having fixed the amount to be paid by the railroad companies for the service of compressing cotton, and by regulating the delivery of cotton to the various compresses, competition between the companies operated by defendant was barely possible under the rules fixed by such commission.

"As to the relations existing between the Western Union and the Bell Telephone system, while I do not believe that it is necessary to pass upon all legal questions involved for the purposes of this report to the Legislature, yet I am free to say that the practical combination between these two great companies trenches upon our anti-trust laws. There can be no competition either in rates or service between two such great concerns where they are practically under the same management and control. This matter shall receive further investigation and consideration at the hands of this department. The department also deems it wise to continue the investigations into the relations, if any, between all these concerns, especially the Postal Telegraph-Cable Company of Texas and the American Telephone & Telegraph Company, the Western Union and the Mackay interests. For a time the Texas Postal was owned and controlled by the Bell system, but, as hereinbefore stated, it claims that it has disposed of that interest. On the question of that branch of the business of the General Electric Company which deals with the manufacture and sale of electrical devices, it will be necessary to conduct a further investigation before it can be definitely stated whether or not any of the pooling arrangements heretofore in existence have been or are now in effect in this State."

Illinois Legislative Notes.

Seven members of a special commission of the Illinois Legislature visited Boston last week and on Aug. 24 held a conference with the Massachusetts Gas & Electric Light Commissioners and the Railroad Commissioners. The Illinois commission is securing material pertaining to the subject of supervision of public utilities and will report to the Legislature of that State in 1913, with recommendations whether Illinois should change its present system of regulation. That State now has a commission on railroads and warehouses which has limited supervision of railroads, warehouses and express companies, but has no control over street railway companies. There has been considerable agitation for increased powers of regulation and the present investigators were delegated to secure data on what other states are doing in that line.

The commission has visited Wisconsin and New York. The former State has a single commission which has supervision over all public-utility corporations. New York has two commissions, each having control over all public-utility corporations, the jurisdiction of one being limited to New York City and of the other to the remainder of the State. Massachusetts has a system of small commissions, each of which has powers of regulation of a single branch of public service.

The visiting delegation was impressed with the difference in cost to the State of the New York and Massachusetts systems. The commission that covers New York City expended about $1,300,000 last year, and this amount was borne by the people, while the three Massachusetts commissions, controlling railroads and street railways, gas and electric light companies and telephone companies, expended less than $200,000, all of which was borne by the supervised companies.

The Illinois commission of investigation consists of: Senator John Dailey, of Peoria, chairman; Senators E. J. Glacken and John F. Denvir, of Chicago; Representatives William P. Holaday, of Danville; Thomas Gorman, of Peoria; Chester W. Church, of Chicago, and William M. Scanlan, of Peru.

New Jersey Commission News.

The Public Utilities Commission has made an investigation to determine the reasonableness of rates charged for electricity and gas by the Consolidated Gas Company of Long Branch. In the appraisal of the property of the company no allowances were made for intangible values, good-will, deficits in early years or uncertain or indefinite matters, but an allowance of 12 per cent was made for engineering, superintendence and other expenses during the period of construction. It is pointed out, however, that it cost at least 20 per cent more to build the plant than the valuation arrived at in the tables, due in part to the fact that the property has been constructed piecemeal and also somewhat to the fact that new and improved methods have been adopted from time to time which involved the purchase of new apparatus. The appraisal value was $1,649,260, but the conclusion of the commission was that it is reasonably certain that the amount of money expended for legitimate capital purposes has been very close to $2,000,000. In the course of the inquiry the general manager of the company stated that, in his opinion, the physical value of the company was between $1,750,000 and $2,000,000.

One of the conclusions of the report is that not enough of the old property was written off to compensate for what it was found necessary to discard from time to time. It is brought out that the Long Branch company, since it supplies a summer resort, operates under very disadvantageous conditions and that it is practically impossible to change materially the shape of the load curves in order to make the operations more economical. The peak load in the daily load curve, for example, has a value approximately six times as great as that of the average load in the daytime. Moreover, a large part of the plant is not used except during a short period in the summer. Among the recommendations of the commission are that some steps should be taken to write off some of the older portions of the plant, thereby bringing the book value to correspond more nearly with the physical value of the property.

An order was issued making a change in electric rates which it was estimated would result, on the basis of 1910

business, in a loss of revenue of $8,975. The old rates were 20 cents for the first 50 kw-hours per month, 16 cents for the next 50 kw-hours and 12 cents in excess of 100 kw-hours, the motor rate being 10 cents per kw-hour for twenty-four-hour service. The new rates are 15 cents for the first 200 kw-hours monthly, 12 cents for the next 200 kw-hours and 10 cents for all over 400 kw-hours, the motor rate remaining at 10 cents per kw-hour.

The commission has ruled that it has no jurisdiction over public utilities operated by municipalities except that it shall require every municipality operating any form of public-utility service to keep its accounts in the manner described for the accounting of similar privately owned utilities and that statements of such accounts shall be filed with the commission; also that for statistical purposes municipalities have been requested to furnish information concerning rates and certain other statistics required of private public-utilities companies.

Wisconsin Commission News.

The Wisconsin commission has dismissed the case of the city of Green Bay versus the Green Bay Traction Company. The city appealed to the commission for an order requiring the defendant company to lay a line of street railway through a certain portion of the city in accordance with the rather indefinite terms of a franchise and agreement entered into between the city and the Fox River Electric Railway & Power Company, the previous owner of the traction system. The nature and indefiniteness of the original franchise provisions were such that, in the opinion of the commission, the present company could in no manner be held liable for any presumed obligation incurred by the Fox River Electric Railway & Power Company.

The commission has handed down one decision in response to two petitions, one by citizens of Platteville alleging discrimination by the Platteville, Rewey & Ellenboro Telephone Company and the other by the company requesting an increase in rates. At the hearing held on the first petition the testimony showed that the company had been making a practice of discriminating between stockholders and non-stockholders in the matter of rates and installation charges. The company attempted to justify its action on the plea that the exchange was a private enterprise conducted for the mutual benefit of its stockholders. In the application for an increase in rates made by the company before the above hearing was held the commission was petitioned to authorize an increase in charges from $1 per month, the present rate to non-stockholders, to a graduated schedule ranging from $1 per month for party-residence service to $2 per month for single-line business service. In the decision covering both petitions the commission denounced the practice of charging stockholders and renters different rates as illegal and ordered the practice stopped. Attention was also called to the point brought out in several previous decisions that the fact that a stockholder or any other person owns his own instrument in no way furnishes a reason for a difference in rates. The reason advanced by the company for an increase in rates was that it was considered necessary to install a complete metallic return because of interference by electric power circuits. On account of the poor condition of the company's accounts, it was impossible to determine accurately what the operating expenses amounted to. As far as could be learned the company can earn about 5⅕ per cent on its present valuation of $35,000 by charging the present rate of $1 per month to all subscribers, including stockholders. With the proposed rate the return would exceed the value which the commission considers ample in cases of this kind. The order, however, authorizes the company to install a graduated rate schedule ranging from $12 per year for party-residence service to $21 per year for single-line business service upon evidence that a complete metallic circuit has been installed. The commission intimated in the order that if the company considered the provisions of the order unfair or harsh its only recourse is to keep its accounts in the manner prescribed by law, which would then enable the commission to deal with the case more intelligently.

The city of Waukesha has filed a complaint with the commission alleging that the rates charged by the Waukesha Gas & Electric Company are unreasonable and discriminatory. A hearing will probably be held during the month of September.

Massachusetts Commission News.

A petition has been filed with the Massachusetts Gas and Electric Light Commissioners signed by a number of citizens of Brockton who ask for the "substantial reduction" in the price of lighting furnished by the Edison Electric Illuminating Company of Brockton. The present schedule of the company is 16⅔ cents per kw-hour for the first thirty hours' monthly burning and 10 cents for all in excess, with a monthly minimum charge of $1 and a discount of 10 per cent for prompt payment. Lamp renewals are free for carbon and gem lamps, and tungsten lamps are sold to customers at cost.

Consumers of electric lighting in Abington and Rockland, Mass., have petitioned the Massachusetts Gas and Electric Light Commissioners for a reduction in the price charged by the Abington & Rockland Electric Light & Power Company. The company now charges a maximum rate of 20 cents per kw-hour with a minimum charge of $1 per month. For store lighting it charges 16 cents per kw-hour for the first fifty hours' use per month of connected load and 7 cents for all energy in excess. It renews carbon-filament lamps on the basis of one 16-cp lamp for each $6 of energy used, free. A discount is made of 10 per cent on all lighting bills if paid in fifteen days.

New York Commission News.

A petition has been presented to the New York City Public Service Commission on the part of a number of societies representing stationary engineers protesting against the low rates accorded by the New York Edison Company to large consumers. Appended to the petition are 212 signatures, and it is stated that its text represents also the views of a joint committee of the International Convention of Steam Engineers, the National Association of Stationary Engineers, the Marine Engineers' Beneficial Society, the New York Engineers' Protective Society, the Blue Room Engineering Society and the National Isolated Power Plant Association. An attorney, Mr. Gustavus T. Kirby, has been retained to represent the interests of the societies before the commission. The charge is that the New York Edison Company is selling electrical energy at less than cost to large users, which deficiency is made up by higher charges to small consumers than are just, and that the average amount it charges for electrical energy is greatly in excess of that which would represent the cost of production and a reasonable return upon the amount invested in plant equipment and distributing systems. It is contended that the energy which a large consumer obtains for 3 cents per kw-hour comes to him in every instance through the same feeders and mains as those which carry energy to the small consumer, for which 10 cents per kw-hour is paid, while the only differential in price between

the large and small consumer is that due to constancy of hours of consumption and the cost of metering, billing and collection.

The Public Service Commission, Second District, has ordered the Delaware & Otsego Light & Power Company to show cause before the commission at Albany on Aug. 29 why an order should not be entered requiring it to make reasonable improvements in its electric generating and distributing system in the village of Otsego. The commission received complaint from the president and members of the board of trustees of the village as to the character of electric service furnished there, and an inspector of the commission found upon examination that the service is irregular in character and generally inadequate and unsatisfactory.

An application for voluntary reductions in electric lighting and motor rates has been made by the Fulton County Gas & Electric Company applying to the cities of Johnstown and Gloversville, to take effect Sept. 1. The rates for lighting are reduced from 5 cents to 8 cents and 10 cents per kw-hour to 4 cents to 9 cents per kw-hour, depending upon the amount used by the consumer. The minimum bill of this company for electric lighting remains at 50 cents per month. Rates for motor service under the new schedule will be from 1½ cents to 9 cents per kw-hour instead of 2½ cents to 10 cents per kw-hour under the existing rate schedules of this company.

The Lockport Gas & Electric Company has been authorized to purchase $32,500 par value of the capital stock of the Lockport Light, Heat & Power Company. This $32,500 of stock constitutes the balance of an original issue of $150,000 heretofore authorized by the commission, and was in the hands of Messrs. Bertrom, Griscom & Jenks, bankers, of New York City, from whom the applicant desired to purchase the same that it might hold all of the capital stock of the Lockport Light, Heat & Power Company in accordance with the Public Service commissions law.

The commission recently had a complaint as to rates charged by the New York Telephone Company in Albany as compared with those charged in other second-class cities. It was shown in the complaint that whereas an annual rate of $90 is charged in Albany for a single-party line, the rate in Buffalo is $84, in Troy, Utica and Syracuse, $60, and in Rochester, $48. It was also shown that the charge for a two-party line in Albany is $66 per year, in Buffalo, $60, and $48 in Troy, Utica and Syracuse, and but $42 in Rochester. The New York Telephone Company, in a letter replying to the commission, admitted differences between rates in Albany and those in the other cities mentioned, but added that these apparent discrepancies are due to the fact that the rates at the other localities are much too low, rather than that the rates in Albany are too high.

CURRENT NEWS AND NOTES.

SALT LAKE CITY ELECTRIC SHOW.—An electric show will be held in Salt Lake City, Utah, Oct. 2 to 7, under the direction of the Electric Show Association of Utah. Mr. B. H. Mindenhall, commercial agent of the Utah Light & Railway Company, is president of the association. A feature will be made of special street illumination during the show and prizes will be given for the most original and best exterior lighting displays.

* * *

GROUNDING THE SECONDARY.—The Denver Gas & Electric Light Company, following two years' of favorable experience with grounded lighting secondaries, is now considering the extension of grounding to three-phase motor secondaries at 220 volts. Fewer personal injuries and transformer troubles have accompanied the grounds now installed, and the management believes that motor secondary grounding will be correspondingly beneficial.

* * *

FEATHER RIVER WATER STORAGE.—Preliminary work has been commenced by the Great Western Power Company on a project for water storage at the headwaters of the North Fork of the Feather River. It is proposed to build a dam at a point 2 miles below the Big Meadows in Plumas County and thereby overflow about 2500 acres of land at an average depth of 25 ft. By tests made with a diamond drill at this point it is found that the company will have to make an excavation about 50 ft. below the surface to reach a solid foundation for the dam. The dam itself will be 150 ft. above the surface and many hundred feet long.

* * *

LONG-DISTANCE TELEPHONE LINES RADIATING FROM CHICAGO.—With competition, and the prospect of increasing competition, the telephone-service companies of Chicago have become liberal advertisers in the daily newspapers. Some interesting statements are contained in these advertisements. Thus the Chicago Telephone Company asserts that 596 telephone circuits (Bell) radiate from Chicago. Most of these are to comparatively near-by points, there being fifty to Milwaukee, for instance, but there are also direct circuits to New York, Boston, Washington, Denver, New Orleans and other distant cities.

* * *

PUBLIC-UTILITY TAX IN CALIFORNIA.—A recent report from the State of Wisconsin mentions that it derives 71 per cent of its public income from corporation taxes, and that no Eastern state approaches this percentage of revenues from such source. The State of California presents, however, figures for the present year which show that it will obtain about 85 per cent of its total revenues from corporation taxes. The total of assessed taxes of electric corporations is $2,689,013, distributed as follows: Gas and electric, $1,224,767; electric railway, $1,039,491; telephone, $399,594; telegraph, $25,160. The total corporation tax of the State comes to $10,455,577.92 for the fiscal year 1911.

* * *

ASSOCIATION ISLAND MEETING OF LAMP MANUFACTURERS.—Among the papers to be read at a meeting of lamp manufacturers at Association Island, N. Y., on Sept. 6 and 7, will be one by Mr. A. D. Page on the commercial possibilities of tungsten street lighting and one by Mr. E. L. Elliott on the attitude of central stations toward tungsten street lighting. The policy to be pursued in furthering tungsten street lighting will be discussed in a paper by Mr. C. W. Bender. Mr. Bender will also present a paper discussing the relative merits of carbon and tungsten lamps for street-car service. The following papers also will be presented: *Competitive Illuminants for Street Illumination*, by Mr. Ward Harrison; *What the Post Manufacturers Are Doing to Develop This Business*, by Mr. C. L. Eschleman; *What the Reflector Manufacturers Are Doing to Develop This Business*, by Mr. C. O. Baker; *Some Co-operative Suggestions*, by Mr. Philip S. Dodd; *Lamp Testing*, by Mr. P. S. Millar; *Specifications from a Railroad Standpoint*, by Mr. J. L. Minich; *Free Lamp Renewals*, by Mr. Henry Schroeder; *Development of Electrical Service in Rural Districts*, by Mr. Caryl D. Haskins; *Co-operation Between the Lighting, Lamp and Contracting Interests*, by Mr. M. L. Barnes; *The Possibilities of the Development of the Incandescent Lamp*, by Dr. C. P. Steinmetz; *Co-operation in Increasing the Business*, by Mr. Frank S. Price, and *The Central Station and the Lamp Manufacturers*, by Mr. John F. Gilchrist. The following topics will be treated by the speakers indicated: *Association Island*, by Mr. F. S. Terry; *Remarks*, by Mr. C. N. Stone, and *Jovianism and the Electrical Business*, by Mr. W. E. Robertson. On Wednesday evening Fra Elbertus Hubbard will speak on business co-operation.

Sons of Jove at Eastern Point, New London, Conn.—A rejuvenation of the Sons of Jove will be held at the Griswold, New London, Conn., on the afternoon and evening of Sept. 9. Delegations will be present from New York, Boston, Philadelphia, Hartford and other Eastern electrical centers. Information in detail will be supplied by Statesman C. McKew Parr, 342 Capitol Avenue, Hartford, Conn.

* * *

Largest Gold Dredger Electrically Operated.—Gold dredger No. 13 of the Yuba Consolidated Gold Field Mining Company, said to be the largest gold boat in the world, has been placed in operation at Hammonton, Cal. The boat is 135 ft. long and the machinery has a total capacity of 720 hp, including a 300-hp motor used to bring the buckets to the surface. The equipment is entirely electrically operated, energy being carried over the water in insulated cables.

* * *

Meter Technique.—A correspondent sends the following verses, which, unfortunately, technical journalistic technique will not allow to be printed in true poetic measure: "Now, considering what makes the rotor rote, this electrical dope is sure sport. Take one little ampere impressed with a volt, and the two make a rotating torque. But who cares for all the precise technique of what makes watts and why? You are sure of the fact when you recalibrate that a few less watts slip by."

* * *

Electric Hoists in Building Operations.—A large number of office or store buildings are now under construction in Chicago, and in nearly every case electric hoists are in use to lift the steel or other structural material into place. Only a few years ago steam hoists were used almost exclusively for this purpose, but the advantages of the electric motor for this work are obvious, doing away with smoke, dirt and noise in busy streets and at the same time reducing the cost of operation.

* * *

Electricity in Japan.—At the end of June there were 367 different electrical companies operating in Japan, representing a total capitalization of $225,423,000. Plants under construction represent $167,767,000 and projects on which work has not yet commenced call for $53,470,000. Of the latter 127 are electric light and power plants and nineteen electric railways. Of capital advanced by Japanese banks during the past to industrial enterprises, amounting to $15,350,000, more than half ($8,900,000) was to electrical companies.

* * *

Independent Long-Distance Telephone Connections for Chicago.—The Illinois Tunnel Company, which operates the competing automatic telephone system in Chicago, recently rehabilitated, announces that it has made long-distance connections with the Independent telephone lines in DuPage and Kane Counties, Illinois. This will give the subscribers of the Independent company in Chicago connection with Aurora, Elgin, Batavia, Naperville, Geneva and other cities and villages in northeastern Illinois. It is said that this is the beginning of a movement which will connect ultimately the Chicago automatic-telephone users with all the Independent lines of the Central West.

* * *

Pioneer Chicago Turbine Erected as a Monument.—The first 5000-kw Curtis steam turbine installed in the Fisk Street station of the Commonwealth Edison Company, Chicago, and later replaced by one of the ten 12,000-kw units now in use there, has been re-erected in the center of a park plot in the grounds of the General Electric Company at Schenectady, N. Y., to serve as a memorial to the rapid development of the steam-turbine unit applied to central-station service. This pioneer turbine was installed in the Fisk Street station in February, 1903. In its present permanent position in the midst of flower beds at Schenectady, the shell of the barely old unit is fitted with a large bronze plate detailing its interesting history.

* * *

An Economical Indiana Motor.—"An automatic motor which may be used for running machinery without the aid of fuel" is reported to be the invention of an Indianapolis man, Mr. A. C. Rutzen, who is said to have succeeded in keeping fourteen electric lamps alight with his machine. "The motor," according to the newspaper man, "somewhat resembles an ordinary compound motor," the resemblance probably having been noted in the construction, which comprises thirty-six steel springs, each 14 in. in length, one spring being wound while the others are supplying power to the motor. A 30-hp motor of this type, says the inventor, can be inclosed in a box 24 in. on a side, and the motor is guaranteed to run until a spring breaks, which may not happen for years!

* * *

The Institute of Operating Engineers.—The following are the papers prepared for the first annual meeting of the Institute of Operating Engineers, in the Engineering Societies Building, New York, Sept. 1 and 2: *Temperature Changes and Heat Transmission,* by Mr. Vernon L. Rupp; *A Boiler-Room Analysis of Coal,* by Mr. J. P. Fleming; *Cooling Towers Versus Steam Pumps,* by Mr. Henry W. Geare; *Engine Lubrication,* by Mr. R. D. Tomlinson; *Reduction of Lubricating Costs in Smelter Power Plants,* by Mr. George L. Fales; *Removing Emulsified Oil from Condensed Steam,* by Mr. Darrow Stage. Addresses will be delivered by Hon. William S. Bennet and Messrs. F. R. Low, D. B. Heilman, A. C. Dougall, William D. Ennis, James A. Pratt and Prof. Frederick H. Sykes.

* * *

Electrified Children.—Prof. Svante Arrhenius, the celebrated Swedish authority on physical chemistry, like Dr. Wilhelm Ostwald, the distinguished German authority in electrochemistry, and Dr. Oliver Lodge, of England, has devoted himself in recent years to the elaboration of philosophical systems and cosmic theories. One of Professor Arrhenius' recent theories is that life was spread through the universe by germs driven by the force of light from one star to another. Another idea has recently been applied to school children in Stockholm. The walls and ceilings of a schoolroom were lined with a coil of wires through which high-frequency current was passed. The children in the room were then in the position of an iron core in the center of a magnetizing coil. Fifty children were kept in this room, while fifty others of the same average age, size and mental development were kept in an adjoining room without electrical treatment. It is stated that at the end of six months the children under electrical treatment showed an average growth of 2 in., while those without electricity grew only 1¼ in. The electrified children showed an increase in weight and other forms of development in proportion to their height. The electrified children also showed an average proficiency in their studies of 92 per cent, and fifteen of them showed 100 per cent. The unelectrified children, on the other hand, were only 75 per cent proficient on the average and not one of them reached 100 per cent. It is added that the electrified children appeared to be much brighter, quicker and more active. They were prompter in attendance and much less subject to fatigue. The teachers also showed superior working capacity in the electrified room. While there was an odor of ozone in the room, it was held that the presence of ozone would not account for the results observed.

COMBINATION HEATING AND GENERATING PLANT AT SPRINGFIELD, ILL.

Unique Features of Flexibility of Equipment in Station of Light, Heat and Power Company.

FLEXIBILITY to an unusual degree marks the design and operation of the interesting plant of the Springfield Light, Heat & Power Company, at Springfield, Ill. This station furnishes electrical energy for local lighting and motor-circuit purposes and for the street railway, and, in addition, during the winter season supplies both low-pressure steam and hot-water systems for district heating.

Both simple non-condensing and compound-condensing engines are installed, and through motor-generator sets in the station the alternators and direct-current generators which the engines drive are interlinked so that either class of service can be carried on either set of engines, according to the demand for power and the conditions of most efficient operation in connection with the heating requirements. One of the converting sets, a three-unit outfit comprising a synchronous motor and two direct-current generators, can also be applied to such varied duties as generating either 250-volt Edison service or 500-volt railway direct current, generating 2300-volt alternating current, or motoring with overexcited fields to raise the station power-factor.

Normally the large compound-condensing engine installed has its condenser supplied with circulating water from a cooling tower, but under certain conditions it has been found more economical to connect the hot-water heating system to the condenser line, thereby raising the temperature of the water and at the same time providing a considerable degree of vacuum to receive the exhaust from the engine. Manipulation of the controllers of several motor-operated valves returns the engine condenser to cooling-tower operation and connects the hot-water system to special heaters supplied with exhaust steam from the simple non-condensing units. At certain times of the year this transfer is ordinarily made several times during the day as fits the conditions of most economical operation with cooling-tower or hot-water circulation.

A second 1500-kw compound condensing unit similarly arranged for operation either with a cooling tower and condenser, or in connection with the hot-water system, is now being installed and will be operated in the same way as the earlier unit hereinafter described and illustrated. In connection with this extension to the plant property a water-softening plant is also being installed, which is unique in the respect that it will be arranged for treating separately the raw make-up water, the cooling-tower water and the condensation from the various units, the purified effluent being then mixed in the reservoir tank which serves as a common source of supply for all units.

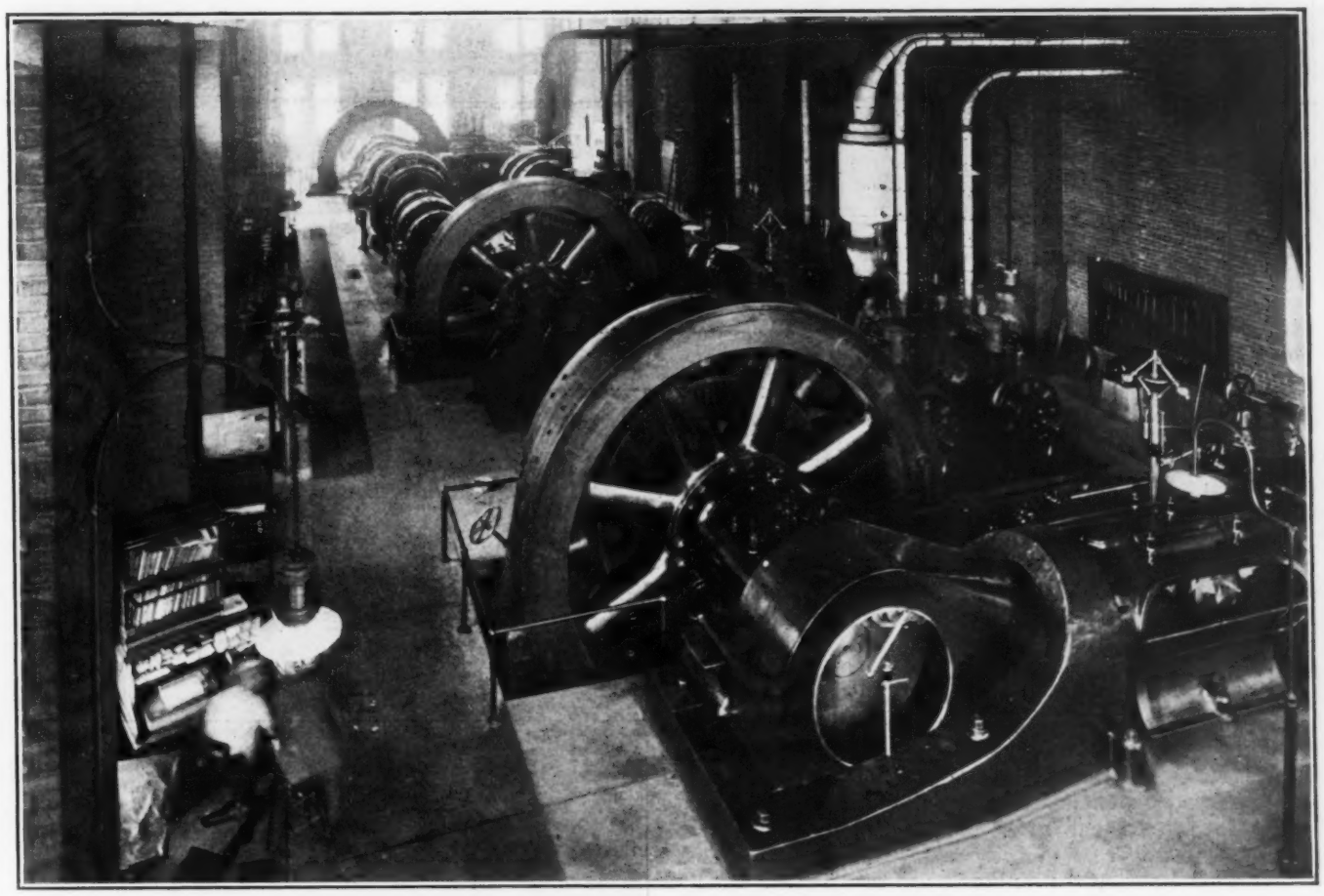


Fig. 1—Interior of Engine-Room, Showing Single and Compound Engine Units.

BOILER-ROOM.

From a spur track alongside the boiler-room coal is dumped from drop-bottom cars into track hoppers which deliver the fuel to hooded chutes opening opposite the line of boilers. As shown in the illustration (Fig. 2) these chutes extend within 12 in. of the floor, below which the coal lies at its natural angle of repose in position to be easily shoveled into the Green chain-grate stokers with which the ten boilers are equipped. Six of these steam-generating units are of the 400-hp Stirling type, two are of the 300-hp Babcock & Wilcox type, and the remaining two are 500-hp McNaul boilers, the ratio of heating surface to grate area being 44:1. All of the foregoing units are equipped with Williams feed-water regulators.

The flue gases on their way to the stacks are conveyed through two Greene fuel economizers, with a total heating

surface of 21,000 sq. ft. Ordinarily the boilers are operated under induced draft created by two overhung fans, 18 ft. 6 in. in diameter, with 5-ft. faces, and driven by 14-in. x 14-in. adjustable cut-off engines. These engines

Fig. 2—Interior of Boiler-Room.

are controlled by automatic regulators which vary the intensity of the draft with the demand for steam. In addition to the forced draft there is also provided one reinforced-concrete stack, 200 ft. high and 11 ft. in diameter, which may be used when it is desirable to shut down both fans.

Ashes from the boilers are dumped into small cars running on an industrial-gage track. The cars can be elevated by means of a hydraulic lift to a runway above a spur track from the street railway so that the ashes can be dumped into work cars to be hauled away.

City water treated in the purifier plant is used for boiler-feed purposes. After being brought through the water-regulating valves on the 3000-hp Cochrane open-feed water heaters this water is passed into the water-back header on the basement ceiling beneath the boiler foundations, from which it is returned to the feed-water heater. Water from the hot wells is also passed through these water backs before reaching the heater. Any possible interruption to the supply of water is eliminated by connecting the water-back header to a 50,000-gal. reserve tank so that in case the supply of water from the city mains and the hot wells should be interrupted the tank will furnish sufficient water to insure the protection of the water-backs against overheating. From the feed-water heaters the water passes through the economizer tubes and is thence delivered into the boilers by one 12½-in. x 9¼-in. x 10-in. admiralty-type and two 14-in. x 10-in. x 15-in. vertical duplex pumps. The temperature of the water entering and leaving the economizer is recorded by Bristol thermometers, while the water evaporated is also registered by a Venturi meter.

The water-softening plant which has recently been put into operation at the Springfield station is of the Kennicott type and is declared by the manufacturers to meet a condition quite unique in power-station practice. The purification plant, in fact, consists of three separate water-softening systems, the first of which is capable of treating 20,000 gal. of raw city water per hour, removing from it carbonates and sulphates of calcium and magnesium which are present in the quantity of about 18 grains per gallon. Although the make-up water in the cooling tower is supplied from the softener and contains but 4 grains to 5 grains per gallon, due to concentration resulting from the evaporation which takes place in the tower, the amount of solids in the cooling-tower circulating water if not re-treated will rise to approximately 8 grains per gallon in twenty-four hours' operation. To eliminate this concentration and keep the hardness of the circulating water down to a point where fouling of condensing tubes will not occur the second section of the softener is designed to re-treat 6600 gal. of water per hour. The amount of circulating water which it is thus necessary to re-treat is approximately equivalent to that which is evaporated in the tower. The third section of the softener treats 8000 gal. of condensation water each hour, removing from it oil and other impurities. After being separately treated the waters from the above several sources are mixed together in a common tank or emergency supply well, which has a capacity of 50,000 gal.

ENGINE-ROOM.

Until the completion of the new extension the 34-in. x 68-in. x 48-in. cross-compound Fulton-Corliss engine driving a 1500-kw, 2300-volt, 60-cycle, three-phase alternator (Fig. 3) remains the only unit in the plant arranged for condensing operation, as above outlined. The other non-condensing engine-driven units are as follows: One 32-in. x 48-in. Fulton-Corliss engine driving an 800-kw, 2300-volt alternator; one 32-in. x 48-in. engine driving an 800-kw, 600-volt direct-current generator, and one 24-in. x 28-in. Fulton engine driving a 400-kw, 600-volt direct-current generator.

The 600-volt direct-current and 2300-volt alternating-current buses are enabled to exchange power through one 400-kw and one 550-kw motor-generator sets. One of these sets is of the three-unit type, comprising a 550-kw synchronous motor driving two 250-volt direct-current generators. Connected in series the generators are thus able to furnish 600-volt energy from the compound condensing engine-driven alternator when the railway demand is light. Connected in parallel they may also be used to supply the 220-volt direct-current motor service, for which two additional 2300-volt motor-generators sets, one of 75 kw and one of 230 kw rating, are especially provided. There are three 30-kw exciters, two of which are driven by General Electric marine-type engines, the third being operated by a 2300-volt induction motor energized from the alternating-current buses.

The condensing equipment of the large compound-engine

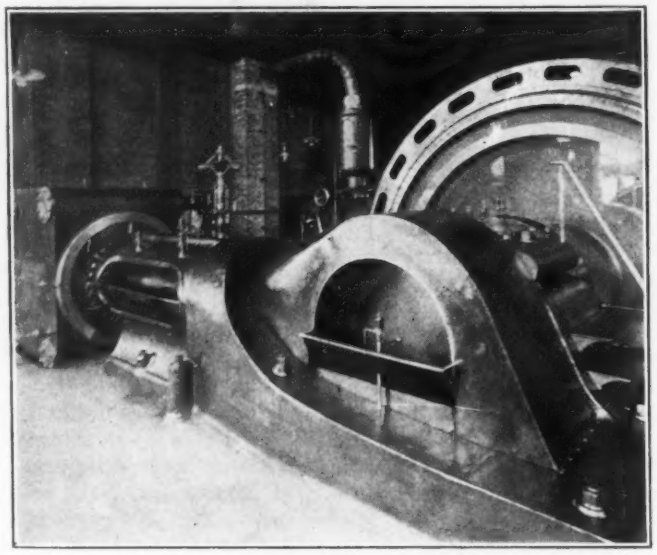


Fig. 3—1500-kw Compound Engine Operated Condensing on Hot-Water Circulating System.

unit consists of a 5500-sq. ft. Alberger condenser, Fig. 4, low-temperature circulating water for which is normally provided by an Alberger forced-draft cooling tower, 22 ft. in diameter and 33 ft. high. This tower is located just

outside of the engine-room wall, and its fan is driven by a 50-hp, 2300-volt adjustable-speed induction motor located within the power house, from which its operation can be controlled through a drum-contactor and oil switch. The

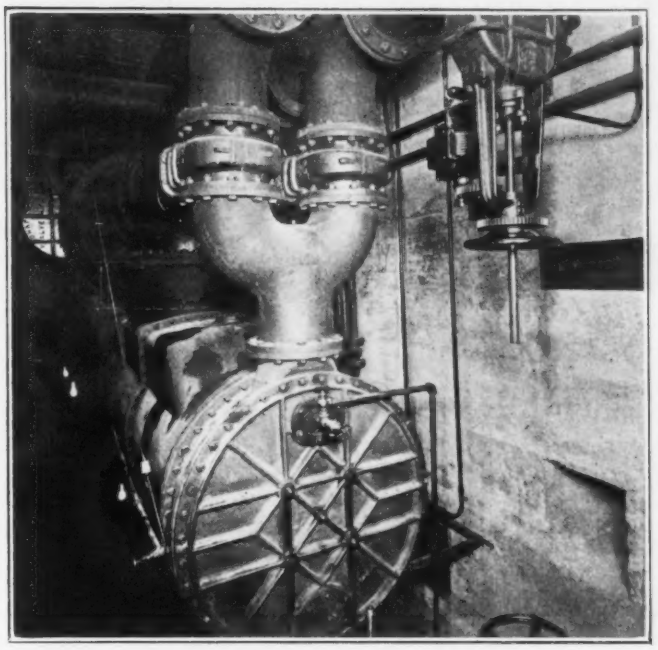


Fig. 4—Condenser for Large Engine, Showing Motor-Operated Valve.

Alberger condenser is provided with a dry-vacuum pump, a turbine-driven centrifugal hot-well pump and centrifugal circulating pump driven by a 2300-volt adjustable-speed induction motor. As shown in Fig. 5, the piping of this condenser is so arranged that the circulating water from the cooling tower may be replaced by circulating water from the hot-water-heating system under certain conditions of operation, as hereafter explained.

The average winter daylight load is carried on the non-condensing units as long as the steam demand of the heating systems is great enough to utilize all the exhaust steam. As has been above outlined, the Springfield plant supplies both exhaust-steam-heating and hot-water-heating systems. The exhaust-steam service is taken directly from the 22-in. exhaust header into which the non-condensing units exhaust. To provide hot water for the hot-water system exhaust steam taken from the exhaust header can be passed through two 3000-sq. ft. Baragwanath condensers located under the roof of the boiler-room. These special condensers are used only for heating the circulating water of the hot-water heating system and lack the usual vacuum and hot-well pumps, the condensation returning by gravity to the feed-water heaters. Hot water can thus be supplied indirectly from the single-cylinder units during average winter daylight conditions.

But as the afternoon peak load approaches the compound condensing unit is added and the hot-water heating system circulated through the latter's Alberger condenser, the transfer to the hot-water-heating system from the cooling tower being effected by six motor-operated valves controlled from a switchboard in the engine-room, Fig. 6. In this way the water of the district-heating system then has its temperature raised by passing through the condenser, at the same time obtaining a partial vacuum for the low-pressure cylinder of the engine.

With circulating water leaving the condenser at a temperature of 150 deg. Fahr., it has been found possible to obtain a vacuum equivalent to a column of mercury 20 in. in height, although, of course, the vacuum obtainable decreases proportionately with the rise of the circulating-water temperature up to 200 deg., at which temperature the exhaust pressure is equal to that of the atmosphere.

In the fall and spring when the heating demand is comparatively light the electric load during the day is carried by the large condensing unit and one of the non-condensing sets. Under these conditions the exhaust from the condensing unit heats the circulating water of the hot-water system, while the exhaust from the non-condensing engine driving the railway generator supplies the steam-heating system. The load between the 2300-volt compound engine-driven generator and the 600-volt simple direct-current generator unit is meanwhile adjusted by the motor-generator sets already mentioned, which divide the demand proportionately to the requirements for steam of the two heating systems.

As the alternating-current load rises and it becomes desirable to increase the output on the condensing unit, further provision is made for tapping steam from the intermediate receiver of the compound-engine unit through an 8-in. reducing valve into the exhaust header which supplies the steam-heating system. Thus practically the full rating may be obtained from the compound unit without impairing the temperature at which the hot-water circulating system would otherwise have to be carried in order to obtain this full load.

Finally, as the lighting peak due to nightfall approaches the circulating water of the hot-water system is by-passed around the Alberger condenser, being replaced by cooled circulating water from the cooling tower already mentioned. The complete layout of the station piping for accomplishing this conversion, which is made about four times daily, is shown in Fig. 5. The six motor-driven valves on the Alberger condenser for controlling the circulating water (one of which is shown in Fig. 4) are manipulated from a panelboard in the engine-room and the conversion can be made without interfering with the engine's operation in the least.

Under peak-load conditions the exhaust steam-heating system is supplied by the single-cylinder units, the circulating water of the hot-water system being heated in one of the Baragwanath condensers. Except in mild weather however, it is necessary to use a great deal of live steam in addition to the exhaust steam released from the engine units. The main steam header is connected to the exhaust header through one 3-in. x 6-in. and two 4-in. x 8-in. Mason reducing valves which lower the terminal pressure to 3 lb. to 10 lb. These reducing valves can be set at the desired terminal pressure, and, although the quantity of exhaust steam varies widely owing to the railway generators, practically a steady head is obtained on the exhaust header, so that the resulting steam demand on the boiler plant is about constant.

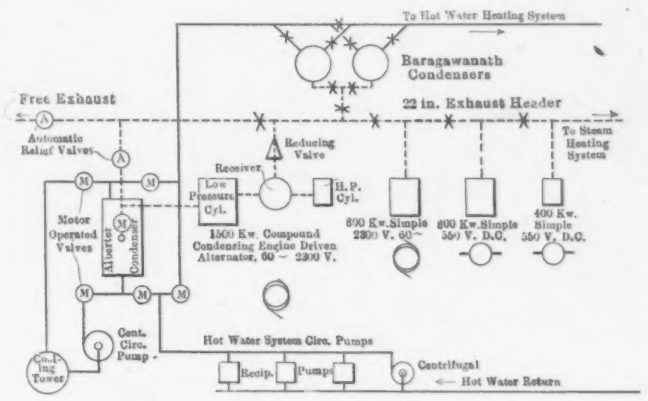


Fig. 5—Layout of Station Piping System.

The number of auxiliaries exhausting steam into the feed-water heater is limited so as to bring the temperature of the water to about 150 deg. Fahr., or above the temperature to produce condensation on the outside of the

economizer tubes. As the demand for steam by the heating system exceeds the supply exhausted by the non-condensing engines, all of the remaining auxiliary steam-using cylinders are arranged to exhaust into the main exhaust header.

The arrangement of interchangeable condensing operation of the large engine unit on either the cooling tower or hot-water circulating system has now been installed and giving satisfactory service in the Springfield plant for more than three years. The principle of operation was devised by Mr. F. C. Chambers, chief engineer of the company, after a series of tests which convinced him of the economies of condensing operation in connection with the hot-water heating system under the conditions prevailing at certain times in the Springfield station. Evidence of the wholly satisfactory character of operation of this novel scheme is afforded by the conclusion of the company to install the new 1500-kw compound-condensing unit under similar conditions, as already mentioned.

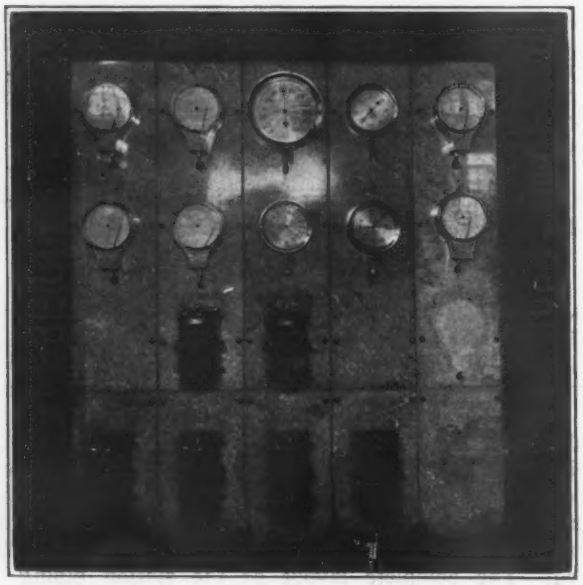


Fig. 6—Gage-Board, with Controllers for Motor-Operated Valves.

The station switchboard is located along the east wall of the engine-room and includes panels controlling both the alternating-current generating and distributing systems, the 250-volt power system and the 550-volt railway system, as shown in Fig. 7. The entire engine-room is spanned by a Pauling & Harnischfeger 20-ton motor-operated crane. The room is illuminated by arc and incandescent lamps hung from bishop's crook and standard fixtures rising from the walls and floor. The power-house structure is of brick with steel-girder supported roof.

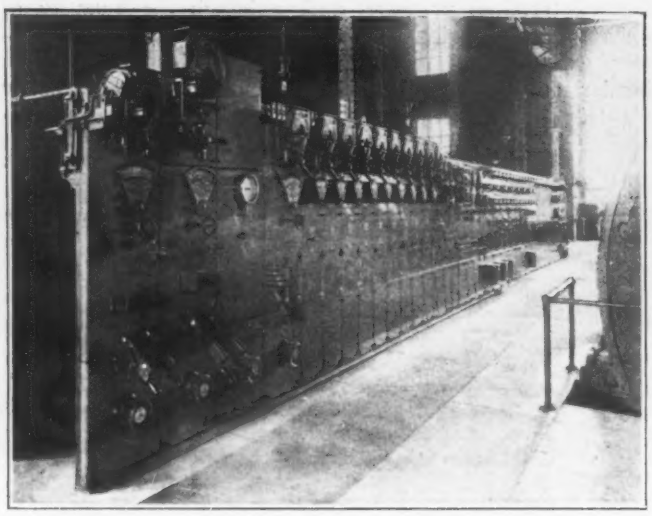


Fig. 7—Switchboard for Railway and Lighting Services.

DISTRIBUTION OF HEATING SERVICE.

The power plant is located at the extreme southeast corner of the territory served by the heating systems. The steam-heating district includes an area in the business section, 3200 ft. x 2000 ft., and has one branch extending 2700 ft. into the residence territory. The mains range in size from 16 in. to 4 in. in diameter and total nearly 18,000 ft. of piping, the major part of which is of variator construction. In addition to the 16-in. main extending from the 22-in. power-house exhaust header to the distribution point, 1800 ft. distant, there is an 8-in. live-steam line which was originally intended for distributing high-pressure steam for commercial purposes, but is now used as an exhaust feeder for the heating system. Under conditions of extreme cold weather the 8-in. line is fed through a reducing valve with a head-end pressure averaging from 10 lb. to 70 lb. Both steam lines are equipped with General Electric steam-flow meters, which are read hourly and the total steam passed recorded on the station log.

The hot-water heating system serves principally the residence territory, covering a district very much larger than that served by the exhaust-steam lines. Three hundred and twenty thousand sq. ft. of radiation are connected to the hot-water system, which comprises about 25,000 ft. of double mains, 12 in. to 3 in. in diameter. These pipes are buried 4 ft. below ground in triple wood boxing, with air spaces between boards, the space surrounding the pipe being filled with oiled shavings. The mains are drained by tile pipe connected to the city sewers. As in the case of the steam-heating system, the cost of service lines is paid for by the consumer and service is furnished on a flat-rate system for the heating season, approximately 250 days.

The older customers' installations are of the choke type and there are also a number of gravity systems, the isolated-plant boilers having been disconnected. New installations are of the double-pipe system, controlled by thermostats, air for operating which is furnished from an underground compressed-air pipe paralleling the main conduit. The hot water for the systems is circulated by one 16-in. x 16-in. x 18-in. Laidlaw-Dunn-Gordon duplex pump, two similar 14-in. x 12-in. x 18-in. pumps and one 12-in. centrifugal pump driven by a 175-hp adjustable-speed direct-current motor. An indicating Venturi meter, Fig. 8, is used to determine the amount of water circulated.

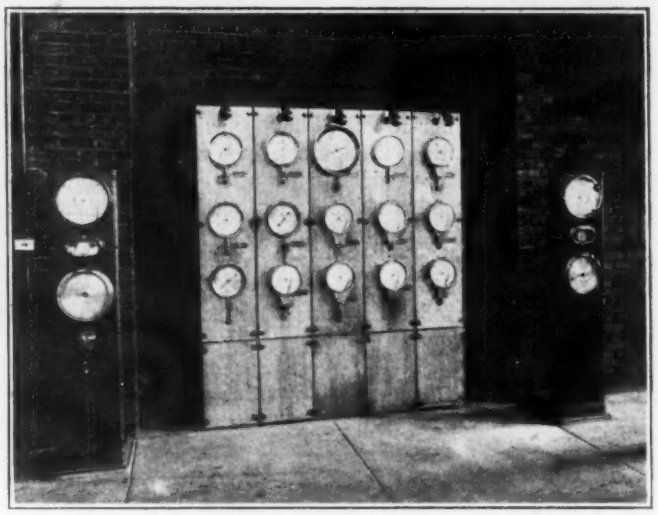


Fig. 8—Gage-Board and Recording Venturi Meters.

The pumps at the station create a differential pressure of 60 lb. between the supply and return hot-water lines. To avoid nearby installations receiving a greater quantity

of circulating water than those in the outlying district, where the differential pressure falls to only 3 lb. or 4 lb., a system of steel-tube orifices has been worked out by Mr. Chambers, chief engineer for the company, details of which were given in a paper read by him before the National District Heating Association convention in Pittsburgh in June.

These orifices were first made up in the form of perforated metallic disks to be inserted in unions in the return pipes, the openings being proportional to the amount of radiation required and inversely proportional to the differential pressure. An account of the experiments made to ascertain the amount of water passed through various-sized openings is given in Mr. Chambers' paper, together with curves showing the results obtained. The original scheme of installing disks, however, was found to produce a whistling effect, which sometimes proved annoying to customers. A number of experiments were then made with disks of different materials and with tapered and countersunk orifices. Trouble was also experienced with the disk orifices enlarging with use due to erosion.

Further experiments then showed that a short piece of tubing could replace the disk orifice in the return pipe without making noise. The opening required was found to be about the same as that for the disk. The tubes are made up of cold-rolled steel, the outside diameter being turned and threaded to the pipe size and an opening being drilled through the solid block of a diameter proportional to the quantity of water to be passed. The installation of these choke nipples had the effect of reducing the quantity of water pumped about 35 per cent and also raising the terminal pressure at outlying districts. The paper by Mr. Chambers above alluded to also shows some interesting results of the saving effected by thermostat-controlled heating services, resulting in a saving of about 60 per cent of the water otherwise required to be circulated without the thermostat.

Mr. B. C. Cobb is president of the Springfield Light, Heating & Power Company, Mr. A. A. Anderson is manager, Mr. Warren Partridge is general superintendent, and Mr. F. C. Chambers is superintendent of the power and heating departments.

DOWNTOWN ARC-LIGHTING SYSTEM OF PHILADELPHIA.

Installation of Twin-Arc Ornamental Posts on the Principal Thoroughfares of the Quaker City.

UP to Jan. 1, 1910, the city of Philadelphia was lighted by over 12,000 9.6-amp constant-current open-arc lamps, those in the central portion of the city being located approximately 200 ft. apart, while those in the suburban districts were spaced from 400 ft. to 500 ft. The service was furnished from five stations located in various parts of the city and containing for the most part synchronous motor-driven 125-light Brush arc machines. The circuits were made up of groups of 125 lamps, the lay-out being so arranged as to minimize the amount of wire and also readily to locate trouble. The older method of lighting still obtains throughout the greater part of the city, but since the early part of January, 1910, when the new system of lighting was installed on Market Street, east of City Hall, the Philadelphia Electric Company has been engaged in extending it, so that eventually it will take in all of the principal business thoroughfares.

Figs. 1 and 2—Market Street, Philadelphia, Looking East and West from City Hall Tower.

At the present time the new system of ornamental arc-

post lighting is in use on Market, Chestnut and Walnut Streets from Delaware Avenue to the Schuylkill River; on Arch Street from Delaware Avenue to Twenty-first Street; on Broad Street from Vine Street to Spruce Street and on the main streets in the immediate vicinity of City Hall. Besides the 556 twin-lamp posts now in service 287 new ones will be installed this year, on Broad Street from Vine Street to Girard Avenue; on Girard Avenue from Broad Street to East Norris Street, on Spring Garden Street from Fifth to Twelfth Street, and on Broad Street from Moyamensing Avenue to League Island Park (Southern Boulevard). Extensions will be made in the future on Broad Street north from Girard Avenue to the city line and on Broad Street south from Spruce Street to Moyamensing Avenue. In addition the company is at present engaged in hanging lamps between columns of the elevated structure on Market Street from the river to Sixty-third Street. The columns of the elevated structure are spaced approximately 50 ft. apart and the lamps will be staggered on both sides of the roadway, giving a spacing of 100 ft. between lamps on either side. This work will require 7 miles of iron conduit, 88,000 ft. of No. 6 rubber-covered and lead-covered cable, and 358 lamps and lamp brackets. This new system replaces the old mast-arm system in use in Philadelphia since the early nineties.

Fig. 3—Philadephia Twin-Arc Post.

The new system of lighting is the result of a number of campaigns of business men's associations for more light. Market Street east of City Hall being the main shopping district of the city, it was only natural that it should receive first consideration and a greater number of lamps than the other thoroughfares. In that section of the city the ornamental posts, each of which has two arc lamps, are located on the Market Street curb lines at all intersecting streets. The distance between corner lamps was divided into thirds, at which points the intermediate lamps are placed. Each block in the shopping district has, therefore, four posts, or eight lamps, on each side of the street. On the other thoroughfares the lamp-posts are staggered instead of being placed opposite each other, so that each block has half the number of lamps. On Broad Street isles of safety with twin lamps are erected at its intersection with the following streets: Spruce, Locust, Walnut, Chestnut, Arch, Cherry, Race, Vine, Wood, Callowhill, Hamilton, Spring Garden, Brandywine, Green, Wallace, Melon, Fairmount, Brown, Parrish, Poplar and Girard Avenue. The islands are in the center of the roadway and on an extension of the house line of the intersecting streets.

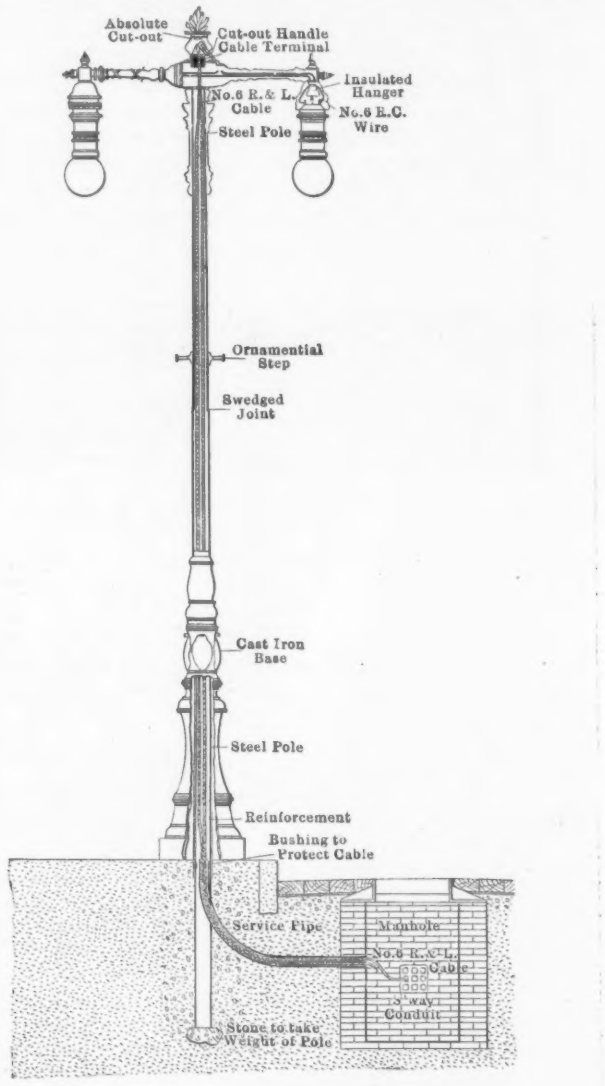


Fig. 4—Details of Post and Connections.

The post shown in detail in Fig. 3 is the result of a prize offered by the T-Square Club for the best original design of a twin lamp-post. The pole proper is made of two lengths of steel pipe, the lower section of 5-in. pipe and the upper section of 4-in. pipe with a swedged joint between. A reinforcing sleeve 2 ft. long and extending 6 in. under ground when the post is set is placed at the ground line to insure longer life to the pole. A slot 3.5 ft. long and 3.5 in. wide is cut in the base of the lower section to allow the service pipe to enter the pole. The steel pole weighs approximately 300 lb. The ornamental base, 8 ft. high, 27 in. lower diameter and 8 in. upper diameter, is cast in one piece and weighs 1100 lb. When in place it is

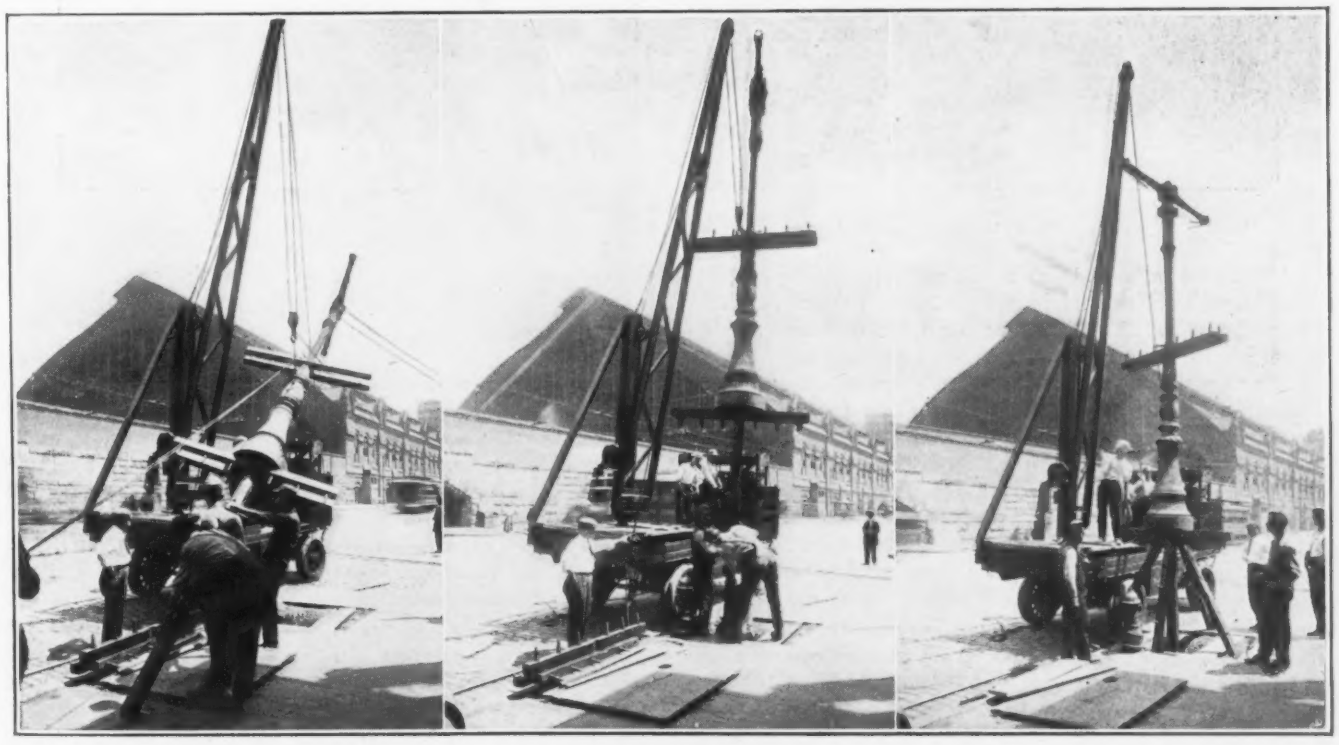
sealed at the top with a compound and at the base by a cement washer to prevent surface water or rain rusting the covered parts of the post. The top fitting or lamp hanger weighs approximately 350 lb. and serves to spread

Fig. 5—Broad Street from City Hall Tower.

Fig. 6—Shopping District on Market Street.

the lamps 6 ft. It is made in a number of pieces in order that it may be conveniently wired. The entire pole is set in place and surrounded with an envelope of concrete about 2 ft. in diameter for a distance of 4.5 ft. below the ground.

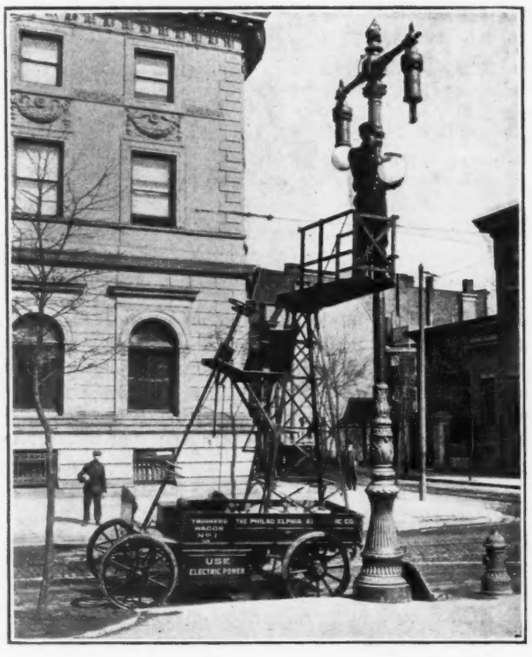
The lamps, which are hung so as to bring the center of the globe 18 ft. above the sidewalk, are of the broad-carbon, open-arc type manufactured by the Philadelphia Electric Company itself. A slight change was made in the design of the lamp case in order for it to harmonize with the general lines of the pole. Each lamp is fitted with a 3-in. x 5-in. x 5/8-in. upper electrode and a 3-in. x 5-in. x 5/16-in. lower electrode. The power consumption is 480 watts and the lamps are trimmed every thirty hours. There is an absolute cut-out provided on each pole so that the lamps can be inspected at any time. The cable is continuous from lamp to lamp, without splices, and ends at the top of the pole in a specially designed terminal amply protected by compound. From the cut-out, which is shown in Fig. 4, direct leads run to the lamp. The circuits are arranged so that the lamps on poles directly opposite on Market Street are fed from different machines and each adjoining pole on the same side of the street is on a different circuit, so that should one circuit fail half of the lamps on the thoroughfare would remain lighted.



Figs. 7, 8 and 9—Method of Erecting Twin-Arc Posts in Philadelphia.

As the poles are not equipped with steps, means had to be provided for trimming the lamps. At first a 24-ft. two-section ladder was set on a quadrant and arranged on an ordinary express wagon so that it could be swung to either side or made to assume an upright position. While this arrangement answered the purpose it necessitated the services of a horse and driver in addition to the arc-lamp trimmer. An electric tower wagon of special design was then evolved by Mr. A. H. Manwaring, arc-lighting engineer of the company. This wagon can be operated from either the upper platform or the driver's ordinary position, and is equipped with a turntable at the top, enabling the operator to trim the lamps on both the street and house sides of the poles. The wagon is constructed on an ordinary 500-lb. chassis, the weight of which, without the tower and including the battery, is 2600 lb. The weight of the tower is 650 lb. The vehicle is equipped with a forty-two-cell, seven-plate Philadelphia storage battery, which will furnish energy to drive it at an average speed of 15 miles an hour and has a mileage capacity of 30 miles a charge. The controller is mounted on an upper platform and can be operated from either the upper or lower seat by a tube outside the steering shaft. The reversing mechanism is a two-slot bushing, keyed on a controller tube which is worked from the upper seat by the foot and from the lower seat by the hand. The steering gear is mounted in the usual manner and is worked from the upper or lower seat by a shaft which runs through the controller. The brakes may be operated from the lower seat by a foot lever in the usual manner and from the upper seat by a foot-lever rod and crank. The upper foot lever has an extension, enabling the operator to set the brakes from the top seat and to climb down and release the brakes from the lower seat, or vice versa. The electric gong is operated from either the upper or lower seat by a floor push in the toe-board. The platform is 13.5 ft. from the ground and by hanging a portable stand from the side rails the height can be increased to either 14 ft. or 15.5 ft., depending on which rail is employed. A test of the stability of the vehicle was made by suspending a 700-lb. weight from the end of the platform when it was turned in the position occupied by the trimmer in trimming the lamps. This test was made before the battery was installed, so that the tower wagon, under the most severe working conditions, has a very large factor of safety. By means of the automobile the trimmer covers his route in approximately six hours, whereas by the older methods nine hours were required to accomplish the same results.

The inspection of the lamps heretofore necessitated the stationing of a horse-drawn wagon and driver at a centrally located point and also the use of a motor-cycle, the operator of which covered the district lighted by the ornamental lamps in about four hours. The latter reported all faulty lamps to the driver, who would proceed to the various locations with the wagon to start or change the defective lamps. Since the electric automobile has been installed there has been no further necessity for the horse-drawn wagon or the motor-cycle, all lamps on ornamental posts being inspected in approximately two and one-half hours and faulty lamps started or changed by the operator, who carries a number of lamps for this purpose on the automobile. The method of trimming or inspecting the ornamental lamps shows a daily saving in the cost of transportation and labor of approximately 33⅓ per cent over the former method.



Figs. 10 and 11—Arc-Lamp Trimmer's Automobile and Its Application.

In installing the ornamental posts a 3-ton electric truck, equipped with a winch, driven by energy from the battery on the truck, is employed. On the rear of the truck a portable derrick, having a lifting capacity of 1 ton, 6 ft. from the center of the boom, is installed. The base of the arc lamp-post is held in position by the clamps, as shown in Fig. 7, and a sling is fastened to the center of the entire post, as indicated in the engravings. The pole is then lifted bodily and warped into position by the erecting crew, after which the concrete is poured about the base; the underground cable connections having been first drawn into the posts.

Needless to state, the displacement of three 480-watt lamps by sixteen lamps having the same power consumption, on Market Street, east of City Hall, and by eight lamps on the other business thoroughfares, was quite a transformation in the lighting of the section contiguous to City Hall. Views are given herewith of some of the main streets, taken from City Hall tower, approximately 500 ft. above ground, from which some conception of the present lighting of these thoroughfares may be formed.

ELECTRICITY IN THE LACKAWANNA VALLEY, PENNSYLVANIA.

Generating and Distributing System of the Scranton Electric Company.

SCRANTON, which is the third largest city in Pennsylvania, has a population of approximately 130,000. Although it is best known as the seat of the great anthracite-coal industry, it is the second silk-manufacturing city in the United States and the thirty-sixth in the value of its manufacturing products. Prior to 1907 the electric service was supplied by a number of electric-generating companies, but these and a number of electric companies in the Lackawanna Valley were consolidated in 1907 when they passed into the control of the American Gas & Electric Company.

The Scranton Electric Company at that time took over three electric-lighting and one live-steam heating company, all of which were struggling for existence. One of the companies was operating a combined direct-current and single-phase, 1000-volt system, together with an extensive series arc-lighting system. Another of the companies was operating a two-phase, 4000-volt system, while still another was using a 4000-2300-volt, three-phase, 60-cycle Y-connected system. In combining these three generating companies it was decided to retain the 400-2300-volt, three-phase, 60-cycle Y-connected system for all distribution except in the business end of the city, where, owing to the large number of motors of all sizes in use, it was decided to employ a three-wire, 110-220-volt system; consequently the old plant of the Scranton Illuminating, Light, Heat & Power Company, on the Lackawanna River, at the extreme end of the business section of the town, was rebuilt and sufficient apparatus installed to take care of the entire downtown section of the city. The installation

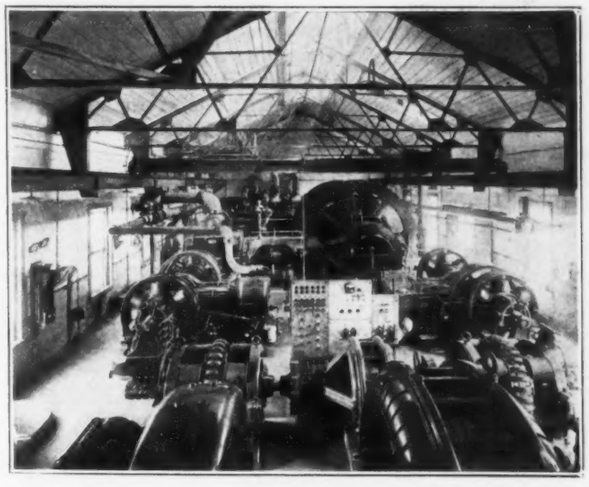


Fig. 1—Downtown Station of the Scranton Electric Company.

in this station at present comprises one 3000-hp twin Corliss engine connected to a 2000-kw, 250-volt direct-current generator and two 500-hp cross-compound Ball engines, each of which drives two 135-volt direct-current generators arranged to work on either side of the three-wire system. There are also located in this station a three-unit motor-generator set, consisting of a 1500-kw, 4000-volt synchronous motor direct-connected to two 750-kw, 135-volt generators, and two No. 12 Brush arc machines direct-connected to a 4000-volt induction motor. The latter supply all of the arc lamps in the center of the city. The boiler plant consists of six 500-hp Stirling water-tube boilers fitted with Dutch ovens for burning culm.

Located about eight blocks east of this steam station is a direct-current substation containing two 500-kw motor-generator sets, which feed energy directly into the center

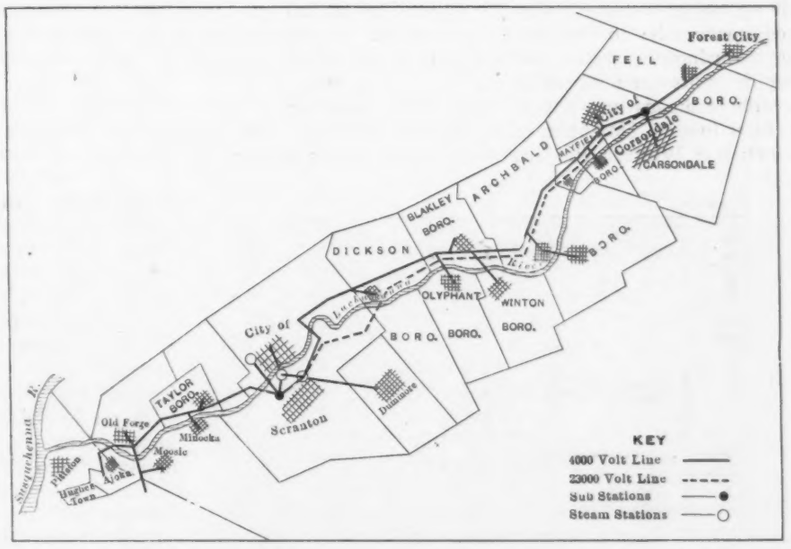


Fig. 2—Map of Territory Served by Scranton Electric Company.

of the three-wire network. Within the past two years all of the wires in the business section have been placed under ground with the exception of wires on some few streets, which will be taken care of this year.

It is so arranged that the steam apparatus in the generating station in this downtown district is closed down during the summer months, the energy being supplied from the motor-generator sets in the plant and in the substation. The alternating-current energy for the motor-generator sets in the station and in the substation is supplied during these months from the main station, formerly owned by the Suburban Electric Light Company.

The main station of the system is that formerly owned by the Suburban Electric Light Company and is located on Green Ridge, a suburban section of the city about 1½ miles from the business center. At this place the company owns 100 acres of land beneath which coal is mined and conveyed directly to the boilers. On the site are also numerous banks of culm, deposited there several years ago when there was no market for the smaller sizes of anthracite coal. The Suburban station at the present time contains one 2000-kw engine-type unit, two 500-kw turbines and one 1500-kw condensing turbine, all operating on a 4000-2300-volt, three-phase, 60-cycle Y-connected system. Early during the present year work was commenced on the remodeling of this station and the installation of one 5000-kw turbine and one 2000-kw engine-type unit. The twelve No. 12 Brush arc machines, at present driven by two 500-hp Erie engines in this station, will be driven by motors when the contemplated improvements are completed. The boiler plant comprises four 600-hp Edge Moor, four 500-hp Stirling and six 400-hp Heine water-tube boilers, all fitted with Dutch ovens.

Exhaust steam for heating purposes is supplied from both of the above-described stations during the heating season, which covers practically eight months of the year.

Until last year this steam was furnished from five live-steam plants located in various sections of the city. The steam-heating system comprises over 11 miles of mains to which are connected various residences and business houses, totaling approximately 700,000 sq. ft. of radiation. The engines in both the generating stations are given sufficient electrical load to meet the demand for steam heating.

Any electrical load in excess of that required to produce sufficient steam for the heating load is taken care of at the condensing unit at the main station, consequently when the heating season is over the Suburban station is operated condensing. Connections are provided so that in case of emergency the engines which operate on the heating system during the winter months can be run as cross-compound units for peak loads in the summer.

The company also has an emergency connection of 5000 kw with the Hampton plant of the Delaware, Lackawanna & Western Railroad Company whereby energy to that extent can be interchanged, the railroad company

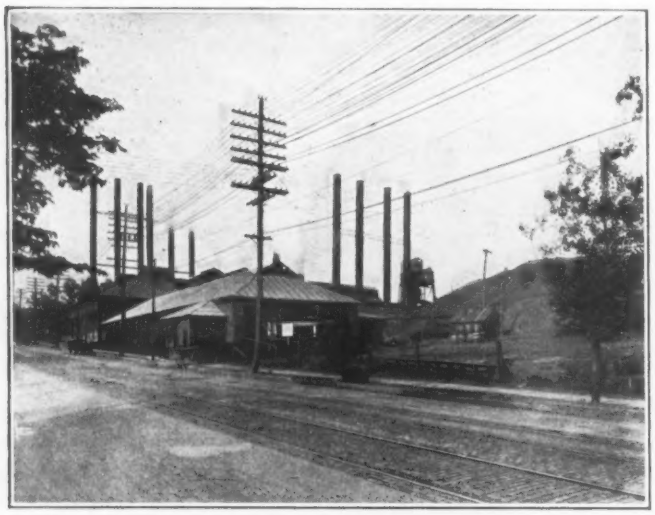


Fig. 3—Suburban Plant with Culm Pile at Rear.

using considerable electricity for mining purposes from 7:30 a. m. to 4:30 p. m., whereas should the electric company require an addition of 3000 kw in the evening it is available at the Hampton plant of the railroad company. Should the railroad company require energy during the day the electric company has sufficient spare apparatus during the day for that purpose.

As stated, the population of Scranton proper is approximately 130,000, and the Lackawanna Valley is thickly populated, so that within a radius of 12 miles of the city there reside in the small cities and boroughs half a million people. Built squarely against the city of Scranton and recognized by the postal authorities as a part of the town is the largest borough in the State, Dunmore, having a population of 20,000.

The lines of the Scranton Electric Company cover practically every town in the Lackawanna Valley, extending 8 miles to the south and 27 miles to the north of the city proper. Twenty miles north of Scranton is the thriving city of Carbondale, with a population of 15,000. Here are also extensive mines, silk mills, iron works and several other diversified industries. The city of Carbondale has the distinction of placing the first hard-coal mine in operation some fifty years ago.

As previously stated, the Scranton Electric Company is owned and operated by the American Gas & Electric Light Company, 30 Church Street, New York City, of which Mr. G. N. Tidd is vice-president and general manager. Mr. Duncan T. Campbell is the general manager of the company at Scranton and Mr. D. C. Shain the general superintendent.

OBSERVATIONS ON THE EFFECT OF THE LIGHT OF THE MERCURY-VAPOR LAMP ON THE EYE.

By Charles H. Williams, M.D.

In an investigation of the effect of the light from the mercury-vapor lamp on the eyes of those working under such light twenty-eight cases were examined, divided into four groups, as follows:

1. Eight cases of men who worked all day under unusual conditions of exposure to the light.

2. Twelve cases of draftsmen who have part of their work by daylight and part under the lamp.

3. Six cases of garage employees who work at night with the lamp for their light.

4. Two cases of women who work all day with the light in a photographic printing-room.

In examining these cases the acuteness of vision was measured in each eye separately with Snellen's test letters at a distance of either 5 m or 20 ft. The condition of the interior of the eye, the optic nerve and retina, was examined with the ophthalmoscope, with the inverted image and also with the upright image, using a frosted 16-cp incandescent lamp for the illumination, and the condition of the refraction of the eye was measured approximately by the ophthalmoscope, using the upright image. The color sense was tested with a full set of Holmgren's worsteds with tags, such as is often used in railway service, and also with the Williams lantern using three lights with medium-sized opening and full current through the lamps of the lantern. In some cases a spectroscopic examination was also made.

The first group of eight cases included five men who have worked from two to eight years in the testing-room of the Cooper Hewitt Company exposed to the glare of scores of tubes on the testing racks; one man who has worked three years in Germany in the laboratory experimenting with the lamp and three years in similar work here, and two men who have done office work under the lamp for five and six years respectively. Their record is as follows, the tests being made during or just after the working day:

1. Twenty-six years old, has worked for seven years in the lamp-finishing and testing-room of the Cooper Hewitt Company. Vision without glasses, 5/5 (normal) in each eye. Fundus (optic nerve and retina) normal in each eye. No appreciable amount of near or far sightedness or astigmatism—that is, refraction normal. Reaction of pupils to light good. With the Holmgren worsteds he selected three confusion colors with the greens as looking like the green-test skein, and one confusion color with the reds with the rose-test skein. With the lantern he made no confusion of red and green, but he confused the greens and reds with the blues.

2. Twenty-one years old, has worked in the testing-room for three and a half years. Vision without glasses 5/5+ in each eye. Fundus normal in each eye. Refraction normal. Reaction of pupils to light normal. With the Holmgren worsteds he selected one confusion color with the greens in the test with the green skein and four confusion colors with the reds when tested with the rose-test skein. With the lantern he confused red and green a number of times and also confused red and green with blue.

3. Thirty-six years old, has worked testing the lamps for eight years. Vision without glasses 5/5— in each eye. Fundus normal in each eye. Refraction normal. Reaction of pupils to light normal. With the Holmgren worsteds he selected four confusion colors. With the lantern he confused reds and greens, and also often called green blue. Similar mistakes were made when the tests were made in the morning and in the evening.

4. Twenty-two years old, has worked in the testing-department. Vision without glasses 5/5 right eye, 5/5—

left eye. Fundus normal in each eye. Refraction normal, also reaction of pupils to light. With the Holmgren worsteds one confusion color was selected, and the selection was hesitating. With the lantern there was no confusion of red and green or blue. With the spectroscope there was quite a broad neutral zone in the blue-green region.

5. Twenty-one years old, has worked two years in the testing-room. Without glasses vision was 5/13 in the right eye and 5/20 in the left eye. He has never used glasses, but the ophthalmoscope showed a myopia (near-sightedness) of considerable amount—between two and three diopters in each eye—which accounted for the diminished acuteness of vision at 5 m distance. The ophthalmoscopic examination showd a normal fundus in each eye. The pupils were slightly larger than normal, with a moderately good reaction to light. With the lantern only a few minor mistakes were made with the colors, mostly with the blue-green confusion.

6. Has been doing clerical work for the past five years, using the mercury-vapor lamp for the larger part of each day. Vision without glasses 5/5 in each eye. Fundus and refraction normal. With the green-test skein of the Holmgren worsteds he made no mistakes, but with the rose-test skein he selected four confusion colors.

7. Has done office work under the lamp for the past six years. He has some myoptic astigmatism and with his glasses the vision is 5/5— in the right eye and 5/5 in the left. The fundus is normal. He made no mistakes with the Holmgren worsteds and with the lantern made only a few minor errors, confusing green and blue.

8. Has worked in German laboratories experimenting with the light for three years and for the past three years in similar work in America. Vision in each eye 5/4 (a little better than the average normal acuteness of vision). Fundus and refraction normal.

The second group of cases, as follows, consisted of draftsmen working in an office lighted for part of the day with the mercury-vapor lamp.

1. Twenty-six years old, has worked one season. Vision without glasses, right eye less than 20/70 of normal and left eye 20/20 normal. The ophthalmoscopic examination shows that the poor vision of the right eye is due to old choroidal changes in the central macular region of the retina, which he said dated back to 1904, before he began to work with the lamp. In the left eye the fundus is normal. With the Holmgren worsteds he readily picked out twenty-one greens as similar to the green-test skein and five reds as similar to the rose-test skein without any mistake.

2. Thirty-three years old. With his glasses acuteness of vision was 20/20 in each eye. Fundus normal. Selected seventeen greens with the green skein and eight reds with the rose skein without mistake.

3. Thirty-nine years old, has worked four seasons under the lamp. With his glasses vision 20/20 in each eye. Fundus normal. Selected seventeen greens with the green skein and eleven reds with the rose skein without mistake.

4. Forty-two years old, has worked four seasons under the lamp. Without glasses vision is 20/20— right eye, 20/20 left eye. There is a very slight myopia. Fundus normal. Selected twenty-one greens with the green skein and ten reds with the rose skein with no mistakes.

5. Thirty-two years old, has worked three seasons under the lamp. Vision with his glasses 20/20 in each eye. Fundus normal. Selected seventeen greens with the green skein and eleven reds with the rose skein without mistake.

6. Forty years old, has worked three seasons under the lamp. Has some myopic astigmatism for which he uses glasses. With them vision is 20/20 in each eye. In the right eye there was a slight haziness in the outline of the optic disk; in the left eye fundus normal.

7. Twenty-five years old, has worked two seasons under the lamp. With his glasses vision is 20/20 in the right eye and 20/20— in the left. Fundus normal in each eye. With the green skein he readily selected eighteen greens and with the rose skein ten reds, without mistakes.

8. Forty-five years old, has worked four seasons under the light. Without glasses vision is 20/20 in each eye. There is a slight myopia, uncorrected by glasses, and a slight congestion of the retinal veins, but otherwise a normal fundus. There was a slight hesitation in the selection of the colors which resemble the green-test skein, but he picked out seventeen greens and with the rose skeins seven reds, without mistake.

9. Thirty-five years old, has worked two seasons under the lamp. Vision and fundus normal in each eye. He selected twenty green skeins with the green and eight reds with the rose-test skein, without mistake.

10. Fifty-three years old. Has some hyperopia in each eye so that without glasses the vision is 20/70 of normal in each eye, but when tested the next day with his distance glasses the vision came up to normal 20/20 in each eye. Fundus normal except disks very slightly paler than normal, but not enough to be considered abnormal. He selected eighteen greens with the green skein and eight reds with the rose skein without mistake.

11. Twenty-seven years old, has worked two seasons under the lamp. Vision normal 20/20 in each eye. Fundus normal. Selected nineteen greens as like the green skein and twelve reds with the rose-test skein without mistake.

12. Thirty-four years old, has worked four seasons under the lamp. Vision without glasses 20/20— right eye and 20/30— left eye. He has a slight uncorrected hyperopia in each eye and a slight congestion of the retinal veins of each eye. Color sense normal.

In the above second group of cases all the ophthalmoscopic examinations were made first with the inverted image and then with the upright image. The color sense was tested with the Holmgren worsteds in clear daylight.

In the third group the examinations were made at night, the men being taken singly from their duties in a garage where they worked at night cleaning automobiles under the mercury-vapor lamp. The color tests were made only with the lantern.

1. Forty-five years old. Vision without glasses 5/50 right eye, 10/50 left eye. The ophthalmoscopic examination shows a very considerable amount (four to five diopters) of myopia with some astigmatism, for which he has never used glasses. Fundus normal. Color sense normal.

2. Thirty-nine years old. Vision 20/20 in both eyes. Fundus and refraction normal. The only mistakes he made in color were the confusion a few times of green and blue.

3. Thirty-eight years old. Vision without glasses 20/30 right eye, 20/40 left eye. Moderate myopia. Fundus normal in each eye. He made a very few mistakes in color, generally a confusion of green and blue.

4. Thirty-seven years old. Vision 20/20 in each eye without glasses. Fundus and refraction normal.

5. Thirty-seven years old. Vision without glasses 20/20 in each eye. Refraction and fundus normal. Slight confusion of blue and green.

6. Twenty-two years old. Vision 20/20 in each eye. Fundus and refraction normal, also color vision.

In the fourth group of two cases of women working all day printing photographs by the light, it was possible to make a much more careful examination, for they came to the writer's office, where the tests were made, directly after leaving work in the afternoon and again before going to work the next morning.

1. Nineteen years old. 5:30 p. m. Has worked with the mercury-vapor lamp for the past seven months. Vision without glasses 5/4— (a little better than the average normal) in each eye. Fundus and refraction normal, also action of pupils to light. When tested with the Holmgren

worsteds with a tantalum-lamp illumination she selected nine green skeins as similar to the green-test skein and four reds with the rose-test skein. With the lantern the only mistake was calling a light-green yellow. With a spectroscope arranged so as to light the upper half of a slit in the eye-piece with light passed through a filter which allowed only the red and green rays to pass, and the lower half with light from a prism which could be slowly moved by the observer so as to match the color in the lower half of the slit to that in the upper half, she set the prism so that the scale of the instrument read 67, 109 and 45 (average, 73). When again examined the next morning at 8 a. m. the acuteness of vision was nearly the same, 5/4 in each eye, fundus normal. In clear daylight she picked out ten green skeins as similar to the test skeins and four reds as similar to the rose skein. With the lantern the only mistake was calling the yellow white and the white orange once. With the spectroscope, however, she made four settings to match the same mixture of red and green in the upper half of the field, and the readings were 59, 59, 69, 65 (average, 63).

2. Eighteen years old. 6 p. m. Has been working three summers and all the past year in the same room printing photographs with the mercury-vapor lamp. Vision without glasses 5/5— in each eye. There is a small amount of myopic astigmatism, 3/4 diopter in each eye, and the fundus shows a slight hyperæmia of the optic disks in each eye, probably due to the uncorrected astigmatism. With correcting glasses the vision comes up to 5/5 in each eye. With the worsteds under tantalum-lamp illumination she selected nine greens with the green-test skeins and four reds with the rose skein. She made no mistakes with the lantern. With the spectroscope arranged as in the last case she made three settings, 105, 81 and 72 (average 86). When examined again the next morning at 8:30 the results were the same as above except that the spectroscope readings were 64, 64, and 60 (average 62).

The principal thing to be noted in these two cases is that at the end of a day's work under the mercury-vapor lamp there was a fatigue in the perception for green, so that in the first case the average of three settings was seventy-three and in the second case eighty-six, but after a night's rest the average in the first case was sixty-three and in the second sixty-two. That is to say, the color of the spectrum which was chosen in the lower half of the opening to match the fixed mixture of red and green in the upper half of the slit stood more in the green at the end of the day's work, and the next morning it stood in its normal position as judged by comparison with other observers, when the effect of the fatigue to this particular color had passed away.

The greater amount of green produces an added temporary fatigue of the eye to the recognition of this particular color, which disappears the next morning. In order to determine where the setting of the spectroscope for the lower half of the field would come in supposedly normal eyes to match the chosen mixture of red and green in the upper half of the field, settings were also made by Professor Cannon, Mary Phelan, office attendant, and the author, as follows: Professor C., 60, 61, 60, average 60; M. P., 60, 59, 61, average 60; C. H. W., 61, 62, average 61.5.

From this it appears that the average of these three observers is very nearly that of the last two cases mentoined above when tested in the morning, or 63 and 62 respectively.

In comparing all the cases examined the fact which stands out most distinctly is that in no case does a careful ophthalmoscopic examination show signs of trouble with the optic nerve or retina which cannot be more properly attributed to other causes. Of the twenty-eight cases twenty-three showed a normal fundus. One case had old changes in the macula region of one eye antedating the use of the lamp, with the fundus in the other eye normal. Three cases showed a slight congestion of the retinal veins probably due to uncorrected errors of refraction. In one case there was a slight haziness in the outline of the optic disk in one eye, when some myopic astigmatism, and normal fundus in the other eye. In no case was any pathological change found in the crystalline lens or the transparent media of the eye, not even where there had been years of work under the most trying conditions possible, where the men were day after day facing the glare of scores of lighted mercury-vapor tubes on the racks of the testing-room.

Immediately after leaving work under the mercury lamp color fatigue was clearly observable, as was to be expected. This was slight at the junction of red and green, the yellowish and green lines of the mercury spectrum apparently tiring the red and green sensations almost equally, and was chiefly observed at the blue-green junction where the greater fatigue of the green came into play. The fatigue is merely temporary, as is well shown in the last two cases described, and was least noticeable in some of the cases who had worked longest under the light, as if the eye had acquired a certain degree of immunity to the unusual stimulus.

Except for this temporary color fatigue none of the cases showed any effects whatever ascribable to the illumination under which they worked.

The thanks of the author are due to Dr. Louis Bell for effective co-operation in the examinations for color blindness.

DIVERSITY FACTOR.

AS already noted in these columns, the Doherty gold medal for the best paper read before any N. E. L. A. company section in 1910 was awarded at the recent national convention to Mr. C. J. Russell, of the Philadelphia Electric Company. The title of Mr. Russell's paper, which was presented before the Philadelphia N. E. L. A. company section in April, 1909, is "Load Factor, Diversity Factor and Power Factor." Below is given a reprint of that section of the paper which treats of the diversity factor. The data employed are in part the result of investigations of day motor loads made by the engineering laboratory staff of the Philadelphia Electric Company.

The proportion of the sum of the maximum demands of the consumers to the actual maximum demand upon the generating station is called the "diversity factor." We hear of many kinds of load factor, yet there is but one standard definition of load factor. Similarly, we hear of all kinds of diversity factor. While the above definition has not been made standard, it is to be hoped that some action will soon be taken on this important matter. For diversity factor is the average relation between the two most important points in connection with any installation upon the system, namely, the maximum capacity demanded by such an installation and that part of such capacity demanded at the time of the maximum demand upon the generating system.

Some attempts have been made to consider diversity factor as based upon connected load. This has been done on account of the ease of calculating such a value. If this method were correct we would have only to divide the connected load by the maximum demand to obtain the diversity factor. This figure would evidently be the same as the station load factor divided by the average use of connected load.

Such a method of computation entirely eliminates an important factor, namely, the relation of the connected load of the installation to the maximum capacity required

to serve its highest demand. In motor installations this ratio may be 1 to ¾, and in residence installations it may be 4 or 5 to 1.

In order to fix the meaning and importance of diversity factor and its effect upon load factor, investment and earning capacity, consider Fig. 1, which shows several classifications of business taken from load diagrams. Here we have 100 kw demand of refrigeration apparatus running from 1 a. m. to 6 a. m., consuming 500 kw-hours; 100 kw demand of motor load running from 7:45 a. m. to 11:45 a. m. and from 12:30 a. m. to 4:30 p. m., consuming 800 kw-hours; 100 kw demand of mill lighting running from 4:30 p. m. to 6 p. m., consuming 150 kw-hours, and 100 kw demand of public-hall lighting running from 7:30 p. m. to 11 p. m., consuming 350 kw-hours. The total consumption of energy has thus been $500 + 800 + 150 + 350 = 1800$ kw-hours.

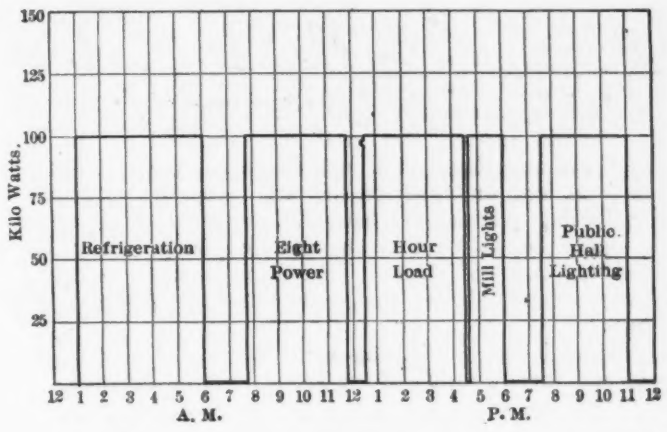


Fig. 1—Diversity of Demand Shown by Different Motor and Lamp Loads.

The sum of the maximum demands was 400 kw, but the actual maximum demand upon the station, ignoring losses, has been 100 kw. The diversity factor is therefore 4. The average use for the day was

$$\frac{1800 \text{ kw-hours} \div 24}{100 \text{ kw capacity}}$$

= 75 per cent of the maximum use possible.

Had the demands occurred simultanously the average use for the day would have been

$$\frac{1800 \text{ kw-hours} \div 24}{400 \text{ kw capacity}}$$

= 18¾ per cent of the maximum use possible.

These examples illustrate the effect of diversity factor upon load factor.

Although we cannot hope to attain this ideal condition in our entire business, it may be well to examine the effect of a small amount of such business as far as investment and fixed charges are concerned.

For this purpose let us assume a plant investment of $200 per kilowatt of rating actually demanded, depreciation charges of 6 per cent and annual stand-by charges of $20 per kilowatt. Applying these costs to the service indicated in Fig. 1, the plant investment stands at $20,000, with depreciation charges of $1,200 and annual stand-by charges of $2,000.

Had the demand occurred simultaneously the plant investment would have been $80,000 and the annual depreciation charge $4,800, with an annual stand-by charge of $8,000. By this combination of business there has been saved an investment of $60,000 upon which we should have had to pay interest or dividends, besides annual fixed charges of $9,600.

Incidentally, the energy has cost less at the switchboard on account of the more uniform rate of manufacture, and this has also had the effect of lowering the cost of all other units being manufactured at the same time. Economies may also have resulted in the investment and fixed charges upon the distributing system, but this has not been taken into consideration.

The importance of diversity factor being established in our minds, we may proceed to examine where and in what manner it actually manifests itself.

Starting at the origin of diversity factor, let us consider the question of the ratio between the connected load upon the premises of the consumer and the actual maximum demand made upon us for capacity during the year. If we assume that every item of a given installation is connected for use at its maximum rating, and really is used at such a rating at some time within the year, it is evident that the ratio mentioned, if other than unity, results from time displacement in the use of the various items; or, if they are all used simultaneously, that their maximum use does not occur simultaneously. Now, the amount of that time displacement is not important as far as the particular installation is concerned. It may be months, as in the case of an electric fan and a luminous radiator. It may be a fraction of a minute, as in the case of a flasher lighting different circuits of lamps of various colors. The benefit gained by these conditions is, as far as a given installation is concerned, that the capacity leased to that customer is less than his connected load and that the average use in a year is greater than if such diversified use did not take place.

It is therefore apparent that all appliances which consume electricity and are used intermittently increase the load factor of the consumer and may do so to a great extent without increasing the amount of his maximum demand. What occurs as between the time of use of the items of a given installation may and does occur between the various installations connected to the system. Magnified by all the possible diversities of use of all the devices connected to our system the same thing results precisely as it does upon the premises of a consumer. Diversity factor results from this and the station load factor is increased without proportionate increase in maximum demand.

Recognition of the importance of diversity factor has played an important part in recent commercial development in the industry, even if the name has not been applied or mentioned in connection with such movements. Some companies have made special efforts to build up a large summer business in supply to park and summer resorts. Brooklyn has built up her diversity factor and her annual load factor tremendously by such steps. Extensions into suburban districts where maximum demands occur at

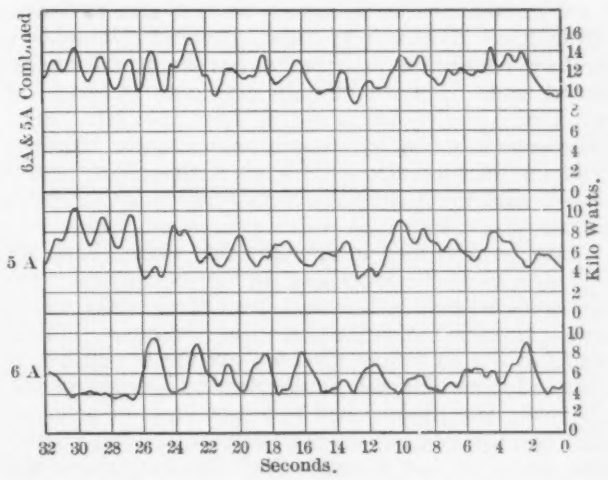


Fig. 2—Individual and Combined Demands of Motor Loads Shown by Curve-Drawing Meters.

hours different from those in the heart of a great city have resulted in increased load factor through diversity factor in the case of many large companies. Campaigns for the introduction of all kinds of appliances in connection with lighting equipments, as well as for restricted-hour business, are all intended to build up diversity factor.

When the electric motor field was first invaded it was believed that a great increase in diversity factor would result. We can readily understand the aims and results in certain of these directions, but perhaps the effects of motor load and other classes of business whose demand, we know, coincides with our peak period are not quite as obvious.

In the lighting field it is apparent that diversity factor must principally result from the mingling of classes of business in which the maximum use does not occur during peak hours. If only 80 per cent of such maximum use existed on the peak the diversity factor in this class of business would be 1.25.

In the motor field we meet with different conditions. Motor and lighting service are used simultaneously in most cases, but in many lines of manufacturing operations by artificial light have a tendency to proceed at a less rapid rate. Again, the economic law of the fatigue of labor assists us. A study of the curves of output in all lines of manufacture will show that the output, and hence the power required, falls off during the closing hours of the day from this cause.

Diversity factor in the power field, however, is also built up from reasons much more important and significant than those just mentioned. We are all aware that most mechanical operations of manufacture are cyclic in character, ranging from a minimum to a maximum demand for power and not consuming power at a constant value. The length of the cycle varies with the application, and we are all well acquainted with some of these cyclic operations, such as in the use of cutting, rolling and hammering machinery. We can readily conceive that if a number of such machines are driven by motors on our system the periods of their maximum use in the cycle of their operations will not be coincident. This actually occurs, and from this diversity factor also results.

Fig. 2 shows the curves taken from two motor installations by recording wattmeters with a combined curve showing the demand of the two installations.

The maximum demand in the lower curve within the period represented upon the chart was 9½ kw. On the second installation the maximum demand was 10½ kw, or a trifle less. The sum of these maximum demands was therefore a little less than 20 kw, but the actual maximum demand made upon our capacity was only 15 kw. It will thus be seen that the peaks in one chart have been absorbed and smoothed out by the valleys in the other. The actual maximum demand also occurs at a time that does not coincide with the highest demands made by either installation.

It may be remarked incidentally that these charts bring out fully one of the strongest arguments in favor of central-station service. Customers are charged only with the amount of energy actually shown on the chart. They do not pay at the maximum rate, but get the benefit of every instantaneous falling off in the demand. What could be more exact and precise than this measurement of actually useful power?

The study of power curves drawn by correct recording instruments is peculiarly interesting and instructive. Similar curves have heretofore been plotted from instantanous readings and from recording instruments of various types, but the results have been rather doubtful to a close student of mechanical movements. On account of the rapidity of the change of rate of the power demanded by cyclic operations it is impossible to obtain practical data in any other manner than with recording instruments.

OPERATION OF SERIES ALTERNATING-CURRENT STREET ARC LAMPS.

By J. C. Lawler.

THE term "2000-cp arc lights" still appears in most municipal arc-lighting contracts and has perhaps caused as much litigation and feeling against the central station as any one thing. The old franchises were made in good faith, "2000 cp" being the manufacturers' rating for the open 9.6-amp, direct-current lamp which consumed approximately 450 watts. This old open arc for obvious reasons was gradually displaced by the inclosed arc and, despite the fact that the wattage consumption is as high or higher on the latter type and its general illuminating qualities are better, it could not in all courts of equity be shown that the inclosed lamp legally fulfilled the "2000-cp" clause. Thus it behooves us to beware of any common phrases that could be misinterpreted in the future.

All municipal arc-lighting contracts should specify the type and ampere rating of the arc lamp to be supplied. In addition, the average wattage consumption, number of hours burned, allowable outage, etc., should be clearly specified, and the company in pursuance of its contract should make a periodic statement showing the operation of its arcs in detail.

Two municipalities demand sworn monthly reports (which will be described later), and the contract specifies

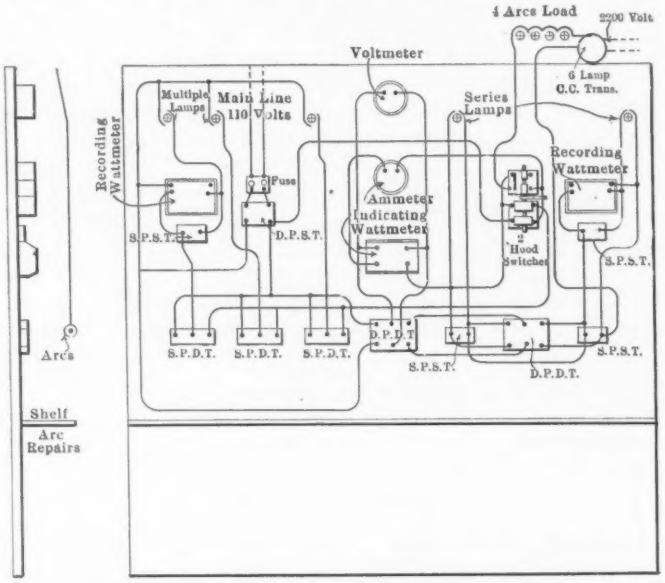


Fig. 1—Testing Board for Multiple and Series Arcs.

that series 7.5-amp, 60-cycle alternating-current arcs are to be supplied and that the average consumption per lamp must not be less than 490 watts. The lamps must burn from dusk until dawn, which is considered as 4000 hours in the aggregate per annum. These contracts are defective in many ways in that some agreements had to be made afterward in regard to line loss, transformer efficiency, method of inspection and allowable outage; however, they present the possibilities for a new contract which should be satisfactory and free from any future misunderstandings.

This form of contract affects the operating department and it must be prepared quickly to test the lamps for a predetermined wattage and maintain its reports in a systematic manner. The following methods and appliances have been adopted by an operating company.

A CONVENIENT TEST BOARD

Fig. 1 is a wiring diagram for an arc-lamp test board. The right end is arranged for connecting two alternating-current series lamps and the left side for three alternating-

current multiple lamps. The indicating wattmeter, ammeter and voltmeter at the center of the board may be used for testing one lamp at a time of either type by properly operating the switches. The board is practically fool-proof, and it is impossible to connect the two types of lamps to the instruments at the same time so as to do any damage. The double-pole double-throw switch directly below the instruments controls the potential to the wattmeter and voltmeter and must be thrown toward the type of lamp under test. On the multiple side the supply current is preferably controlled by a double-pole, single-throw switch protected by fuses. The three test loops for the multiple lamps are each controlled by a single-pole, double-throw switch. Any one of these switches thrown to the left (away from the instruments) permits the lamp on that loop to burn independently of the instruments. When the switches are thrown to the right the lamp is connected to the loop controlled on the instruments unless the series lamps are already on the instruments, in which case the multiple lamp would be extinguished.

The series circuit is supplied by means of a six-lamp constant-current transformer through a bank of four lamps for load. There are two series test loops controlled by two single-pole, single-throw short-circuiting switches. The potential for the voltmeter and wattmeter is controlled by a double-pole, double-throw switch which must be thrown toward the series lamp under test. The series lamps may be thrown off or on the indicating instruments by means of two absolute cut-out hood switches, which form the principal part of the "fool-proof" device. These two hood switches are placed end to end so as to be operated by one handle or lever; the lower hood switch, as shown, has the short-circuiting bar removed and operates as a two-pole, single-throw switch. These switches are so connected that with the lever thrown to the right (away from the instruments) the series lamps are short-circuited from the instruments and the lower switch completes the multiple circuit through the instruments. When the lever is turned to the left the series circuit by means of the top hood switch is completed through the instruments and the multiple circuit is broken by means of the lower hood switch. One test circuit of the multiple lamps and one test circuit of the series lamps are provided with a recording wattmeter and short-circuiting switch. The latter meter should be adjusted for 72 volts, and both for low power-factors. The test circuits should be suspended in front of the board at a convenient height.

METHOD OF TESTING ALTERNATING-CURRENT SERIES-ARC LAMPS.

It is desirable to have all lamps on the circuits consume as near a predetermined rate as possible. The lamp consumption not only depends upon the internal adjustment of the lamp, but there are several things beyond our control which must be allowed for.

Weather affects the consumption on a circuit of series lamps as much as 10 per cent. This is principally due to the variation of temperature in the shunt coil. When the shunt coil is at a low temperature and consequently low resistance it will pull a shorter arc, thereby reducing the voltage across the arc with a resultant lower wattage. The series coil is not perceptibly affected by the change in temperature, as the constant-current transformer maintains it at a constant strength. The line loss is less in cold weather, and where this loss is taken at a constant percentage the lamps must be operated at a slight percentage above the demanded rating.

The length of carbon also affects the consumption. The longer the upper carbon the heavier, and it tends to produce a shorter arc. A circuit of arcs newly trimmed will show a decided decrease in consumption partly caused by the greater weight, but principally due to the low resistance of the carbon tips, and even while the arc may be excessively long the consumption will remain low. It requires approximately forty minutes' burning before the carbons reach a normal condition.

Fig. 2 shows the variation in the average consumption in watts on a circuit of series arcs taken for a continual run of twelve hours with practically constant outside temperature. It will be noted that the minimum occurs when the lamps are first turned on and are cold. The consumption increases over three hours as the lamps become warmer and as the arc becomes longer due to the carbon tips being consumed. Between three and four hours after the arcs are started the "feeding point" is reached. Some lamps will extinguish themselves for an instant and start at a low consumption as the feeding takes place. Other lamps will feed a perceptible amount every few minutes, probably never extinguishing themselves, and will operate at a fairly constant rate. It is the feeding point that causes the watts to drop, but it will be noted that this drop is not as low as at the original starting point. The continual heating and shortening of the carbons cause each successive feeding point to reach a higher consumption than the preceding one. For this reason an eight-hour test will show a lower average consumption than a twelve-hour test. The high consumption caused by the long-hour burning in winter may be offset by the colder weather.

As eight or twelve hours is too long for a practical test in the shop on individual lamps, the following short method may be adopted for the 7.5-amp and 6.6-amp lamps:

The lamp should be trimmed with used carbons of about half length and allowed to burn on the test rack for at least forty minutes. It should then be switched on the indicating instruments and the short-circuiting switch thrown in for an instant until the carbons have dropped together and the magnets fallen. The switch is then opened and the ammeter is noted to see if it indicates the proper

Fig. 2—Composite Curve, Showing Average Watts per Lamp Consumed on a 7½-amp Alternating-Current Arc Circuit.

amperage. If the lamp under test is of the 7.5-amp type the indicating wattmeter should show 470 watts. This may be called the starting wattage. Then the carbon is held firmly against its guide and at the same time the series magnet and mechanism pushed down until the clutch can take a new hold of the carbon at as low a point as possible. The mechanism is then released, and when the clutch has taken hold the grasp on the carbon is released. The indicating wattmeter should within a minute read 510 watts to 515 watts. This is the "feeding point" and the lamp should soon drop its carbons and wattage. This test requires some practice and several trials, but a lamp so adjusted will average from 495 watts to 505 watts on long-hour burning.

Nearly all new lamps are fitted with a clutch stop which prevents the globe cap from melting when the lamp is newly trimmed and the arc is excessively long; however, care must be taken to see that the bar of the stop is placed sufficiently high to prevent the clutch from striking it before the feeding point is reached. The bar should not touch the clutch while the lamp is under normal running condition.

A worn clutch will permit the carbons to slide together, and if a new clutch is placed on the lamp care must be taken that it shall have as much play and grasp the carbon

like the old one, or it may be necessary to readjust the entire lamp.

METHOD OF INSPECTION.

Requiring an exceedingly careful supervision of its street arc lamps, one company placed night inspectors on regular routes to see that all lamps were kept burning. These inspectors carried regular night watchman's clocks and were compelled to visit certain remote stations in order to get their registering keys. They made two rounds of their circuits every night and turned in their clocks to a supervisor every morning with their reports. From these reports the lamp-hour outages are obtained. Following is an arc inspector's report:

Time Found.	Location.	Cause.	Lamp Hour Outage.
8:10	5th and A St.	Carbon stuck	1 hr. 10 min.
8:30	9th and B St.	Br ken inner globe	1 hr. 30 min.
9:00	5th and A St.	Carbon stuck changing lamps	40 min.
Total lamp-hour outage			3 hrs. 20 min.

A lamp is considered as "out" from the time the circuit was turned on or off from the time of the last inspection. This record enables the superviser to "spot" a lamp which continually gives trouble; also, the greater number of actual outages found prevents the company from having to operate its burning lamps so far above normal in order to maintain the required average watt consumption. Experience has shown that a newly trimmed circuit will show abnormal outages.

Following is a form of monthly arc-lamp report furnished the city:

1.	Total number of hours burned	406 hrs. 27 min.
2.	267 lamps in service first of month, lamp-hours	108,522
3.	One lamp installed 27th, lamp-hours	57
4.	Total apparent lamp-hours	108,579
5.	Total lamp-hour outages	295
6.	Net lamp-hours	108,284
7.	Watt-hours, primary	61,878,000
8.	Watt-hours at lamps (87 per cent)	53,833,860
9.	Average watts per lamp	497.1

The first line indicates the total number of hours the lamps were turned on during the month. The second the number of lamps in service the first of the month multiplied by the hours burned, giving the apparent lamp-hours. The third indicates the lamp-hours of lamps that were installed during the month. The fourth is the sum of the second and third, giving the total apparent lamp-hours for the month. The fifth is the total lamp-hour outages taken from the night inspectors' reports. The sixth is the net lamp-hours burned. As to the seventh line, the recording watt-hour meters were necessarily placed on the primary of the constant-current arc transformer and were agreed to have an efficiency of 94 per cent. The line was entirely of No. 6 copper and the loss was originally taken according to the C^2R losses. This came so near a constant percentage that the combined efficiency of the line and transformers was fully agreed on as 87 per cent. Thus the eighth line shows 87 per cent of the seventh line. The ninth line is the eighth divided by the sixth and gives the average watts at the terminals of the lamps.

Owing to sudden weather changes it was found advisable for the superviser to keep his report practically up to date during the month in order not to run short or be far above the required watts at the end of the month. The watts could be changed very readily by making a slight adjustment of the weights on the constant-current transformer, which would cause scarcely any perceptible variation of the ammeter.

SUMMARY OF MONTHLY REPORTS.

Month.	Lamps Burned Hours.	Lamps Burned Minutes.	Net Watt-Hours Consumed.	Number of Lamps.	Apparent Lamp-Hours.	Hours Outage.	Net Lamp-Hours.	Per Cent Outage.	Watts per Lamp.
January	406	27	53,833,860	268	108,579	295	108,284	.0027	497.1
February	345	11	47,027,000	270	92,871	352	92,519	.0038	503.3
March	344	03	46,895,510	274	93,923	473	93,450	.0050	501.5
April	293	00	40,401,930	275	80,431	301	80,130	.0037	504.2
May	269	46	36,821,880	276	74,456	207	74,249	.0028	494.5
June	239	36	32,999,100	276	66,130	*1,052	65,078	.0159	507.1
July	270	50	37,798,890	276	74,750	161	74,589	.0021	506.8
August	309	15	41,324,478	276	85,353	446	84,907	.0052	486.7
September	332	13	46,666,800	276	91,692	484	91,208	.0053	511.6
October	375	09	50,983,740	276	103,541	613	102,928	.0059	495.3
November	395	58	53,743,380	276	109,287	682	108,605	.0062	494.9
December	424	31	58,056,840	276	117,167	*2,281	114,886	.0195	505.3
	4,005	59	546,527,408	....	1,098,180	7,347	1,090,833	.0067	501.0

* High due to lightning and wind storm.

PRODUCTION COSTS IN PROGRESSIVE CENTRAL STATIONS.

THE analysis of the cost of producing electricity at the busbars of a modern central station is a problem of constant interest. The steady development of new business in the past five years has been a conspicuous feature of the industry, and its introduction of fresh sources of income has often obscured the importance of generating economies. Multiplication of output inevitably attends the growth of revenue, and consequently there is a constantly greater incentive in a growing plant to bring about small economies of production. It is coming to be usual for even medium-sized stations of a few thousand kilowatts rating to produce between 2,000,000 kw-hours and 8,000,000 kw-hours per year, thanks to the growing industrial and social popularity of electric service. A saving of even one-tenth of a cent per unit thus means that the company's yearly expenses are less by from $2,000 to $8,000, and once an economy capable of making a decided saving is established its good effects are readily maintained.

It is only within the past three or four years that the net manufacturing cost of electricity produced in steam plants of small and moderate capacity and good management frequently ran between 1.5 cents and 2 cents per kw-hour. That is, the net station expense, without allowing for interest, taxes, depreciation, insurance, legal, distribution, collection and other expenses, reached the limits above stated even in the practice of stations which gave special attention to the problems of power production and which were never slow to introduce labor-saving equipment of reasonable first cost and reliable service. To-day these stations are very generally producing electricity at a net manufacturing cost, exclusive of any fixed charges

or expenses outside the station building, of not far from 1 cent per kw-hour. Many causes have contributed to this result, which, it must never be overlooked, is in no sense a criterion of rates, for there is a wide gap between the mere fuel and labor expense, so to speak, of putting a kw-hour on the station busbar and the cost of delivering it at the consumer's meter. The station cost, however, is of profound technical and administrative interest, since slight economies effected all along the distribution system are multiplied back to the generating plant, and, in view of the tendency of this cost to approximate 1 cent per kw-hour in some of the best plants of moderate size, it is well to consider some of the elements of expense which appear in their records.

Plant 1 is a combined turbine and engine station which in 1910 produced 2,428,940 kw-hours at its switchboard and sold 2,004,026 kw-hours. The company has for several years been developing an attractive motor load, with the result that last year customers with motors purchased 1,329,661 kw-hours, or about 66 per cent of the total energy sales. The company burned during the year 4230 tons of bituminous coal at an average cost of about $3.90 per ton, and the station expense per kw-hour, including fuel, oil and waste, water, station wages, repairs and a few miscellaneous items of small consequence, was 1.18 cents. This excellent showing is interesting in view of the size of the plant, which had a normal rating of 2339 kw, consisting of two horizontal Curtis turbo-alternators of 750 kw rating each and three steam engines driving two direct-connected and one belted generator installation. Five engineers and three firemen handled the plant, including all shifts. The maximum load on the station during the year was 1200 kw, giving a load-factor of 23 per cent. The steam supply was provided by six water-tube boilers aggregating 1349 hp and the operating steam pressure was about 140 lb. This station is gradually undergoing a transition from an engine-driven to a turbine plant; the condensing-water facilities are being improved, with special reference to reliable circulation and better cooling arrangements; an old waterwheel equipment of about 60-hp rating has been replaced by circulating-water conduit facilities of ample capacity and assured flowage, and the expansion of the station has been effected along lines which tend in the long run to enable the machinery to be supervised and maintained by practically a stated force of men. Another feature of the plant which tends toward economical operation is a provision for gravity delivery of coal from cars hauled by electric motors to a trestle immediately outside the boiler house. The total station expense for the year was $28,713, the two larger items being fuel, $16,449, or 0.68 cent per kw-hour, and labor, $9,399, or 0.39 cent per unit.

Plant 2 is another station of moderate size, its rating being 3000 kw. The installation is practically new, consisting of four water-tube boilers rated at 2100 hp total and two 1500-kw Curtis turbines of the vertical type. The extensive cultivation of new business by the company has resulted in its enjoying a large sale of energy in proportion to the size of the station. Last year the company generated 8,079,038 kw-hours, of which it sold 6,401,778 units. Motor users purchased 2,507,232 kw-hours. In spite of the fact that the cost of coal was $4.27 per ton, or 37 cents higher than in plant No. 1, the company produced electricity at a fuel expense of 0.56 cent per kw-hour. The labor cost at the station was 0.29 cent per unit and the net manufacturing cost 0.89 cent. The large volume of output contributed to the success of the plant in attaining a low cost of manufacture, and it is probable that this will be carried still lower as the service of the station extends and the equipment can be operated on the average at points nearer its full-load efficiency. The plant is provided with efficient mechanical coal-handling apparatus, with modern auxiliary equipment in connection with the feed-water and condensing service, and the arrangement of apparatus is such as to enable a high capacity in generating machinery to be handled by a limited number of station attendants. Four engineers, three oilers and seven fireroom attendants are at present required, but as the plant expands very small additions will have to be made to the labor account for some time. The installation of the major portion of the condensing apparatus in the turbine-room enables the equipment to be handled and maintained with minimum travel about the plant. The total station expense for the year was $71,766, the two largest items being fuel, $45,438, and station wages, $18,436. It is worth noting that the second station produced about 3.3 times the output of the first with only 2.5 times the expense. The station load-factor for the year was 33.3 per cent, defining it as the ratio of the average to the maximum, and the station factor, so called, or the ratio of the average load to the plant rating, was 30.7 per cent. The operating steam pressure in the boiler-room was 175 lb.

Plant 3 is a station serving a large suburban residential district, with sales of electricity to other communities near by which have more or less off-peak consumption, with a large lighting peak at the seaside in the summer season. The station equipment is mainly driven by steam engines of the compound condensing type, although the latest unit installed is a turbine set rated at 1500 kw. The total station rating is 3400 kw. Last year the company generated 5,513,034 kw-hours and sold 4,738,369 kw-hours. The motor-circuit sales were 1,482,424 kw-hours. In spite of the fact that the design of the station required the services of seven men in the engine-room, two steam fitters, three firemen and two switchboard men, the labor cost for the plant for the entire year was only $13,773, or 0.25 cent per unit. The fuel cost, made up mainly of soft-coal charges at $3.99 per ton, came to $29,851, or 0.54 cent per kw-hour, and the total station cost, exclusive of any fixed charges, was $58,224, or 1.05 cents per kw-hour. A feature of this plant, which is located in a district dependent upon city water, is the use of a large motor-driven cooling-tower installation which has resulted in the efficient handling of water and the repeated use of circulation supplies. The maximum load on this station in the year was 1980 kw, giving a load-factor of about 32 per cent. The steam-generating equipment consisted of a modern plant of four water-tube boilers with a combined rating of 1910 hp, supplied with coal by an installation of mechanical stokers and a complete equipment of coal-handling apparatus, with crusher and conveyors of modern type. The operating steam pressure in the plant was 158 lb. It is probable that the existing operating costs will be somewhat reduced as the campaign for suburban motor load makes further headway.

Plant 4 is that of a company under the same general management as No. 3 and located within tie-line distance of it. The two plants are usually so run that the smaller station is shut down except in hours of loading sufficient to give its equipment good economy, electricity being purchased from the related plant and also from an adjacent central station under a separate management. The equipment consisted of a Westinghouse-Parsons turbine of 500 kw rating and two revolving-field alternators direct-driven by Rice & Sargent horizontal, cross-compound engines. The total rating of the electric generating machinery was 1400 kw. Simplicity of design marked the plant and its operating schedule required the services of but three engineers and three firemen. Hand-firing was used and the steam pressure carried was 135 lb. The plant delivered 2,089,200 kw-hours at the switchboard last year, sold 1,538,793 units and disposed of 111,596 kw-hours to motor users. The latter is almost insignificant and could have but small effect on the station economy, but the plan of operating the equipment so far as practicable during hours when the demand upon it was sufficient to load the machin-

ery favorably resulted in a manufacturing cost at the station of 1.07 cents per kw-hour, the total station expense, excluding annual charges, being about $22,492. The chief items of expense were fuel, $11,993, and station labor, $6,277, the kw-hour costs for coal and attendance being 0.57 cent and 0.30 cent respectively. In this station the cost of water was rather higher than usual in a plant of its size, the company being obliged to pay $1,066 for this supply. Steam-plant repairs during the year also increased the operating expenses at the station by $1,616. Four water-tube boilers of a total rating of 1208 hp supplied the steam service. The maximum load during the year was 1200 kw and the company's chief fuel consisted of Cumberland coal at a cost of about $3.86 per ton.

Plant 5 illustrates the beneficial effects of a well-sustained electric-railway load on a station whose generators are driven in part by belted engines. The station supplies a small electric-lighting business, but of its total energy sales of 4,103,384 kw-hours, 3,636,390 units were purchased by a large electric-railway system. The total energy generated during the year at the station was 4,357,648 kw-hours. The plant produced electricity at the creditable figure of 1.15 cents per unit in 1910, the total station expense being $50,294. The cost of fuel was the chief element of expense in operation, rising to $34,228, or 0.78 cent per kw-hour. The company burned a mixture of soft coal and No. 3 buckwheat during the year, the former costing $3.94 per ton and the latter $3.17. The maximum load during the year was about 1900 kw; the labor cost was $9,610, or 0.22 cent per kw-hour, and the steam-plant equipment repair cost was $2,966. Three engineers, three firemen and two coal passers were on the station payroll. The generators consisted of seven units rated at about 2435 kw, only two of the generators being of the direct-connected type. The boilers were nine in number, of the horizontal, return-tubular type, operating at 115 lb. steam pressure. The striking point in the plant expenses for the year is the disparity between the fuel cost and the balance of the station expenditures. It is impossible to escape the conclusion that if modern direct-connected apparatus should be installed in place of the considerable amount of belted machinery now in use the plant would reap the benefits of a decided increase in production economy. It is a question whether the labor account could be reduced per kw-hour by such changes in the machinery, for the relatively large output of the plant enables the company to enjoy a labor cost per kw-hour considerably below that often encountered in stations of this size.

Plant 6 serves a large city of residential type, with a rapidly developing electric-motor load in a manufacturing section. The company's total output at the switchboard in 1910 was 7,344,392 kw-hours and its sales were 6,566,420 kw-hours. The progressive exploitation of a motor load brought the company during the year the income from 3,027,476 kw-hours. The maximum load during the year was 3100 kw. The company produced electricity at the bus at a net station cost of $69,141, or 0.94 cent per kw-hour. The fuel, New River coal at $3.57 per ton, was brought to the station by barges on a river flowing past the plant and fired into the boiler furnaces by hand. The coal cost per kw-hour was 0.42 cent, the total fuel bill being $34,092 for 1910. The steam-generating equipment consisted of eight 400-hp boilers operated at 160 lb., and the rating of electric generating equipment was about 5200 kw. There were three main generating units, each consisting of a revolving-field alternator direct-driven by a vertical, cross-compound condensing engine. A direct-current motor load was also supplied by means of two 250-kw motor-generator sets in the station. The station payroll covered four engineers, five firemen, three oilers, two coal passers, four switchboard men and one wiper, and the total station labor cost for the year was $21,962, or 0.30 cent per kw-hour. The station-building design is possibly a little more complicated than in many plants of recent construction, and the arrangement and character of machinery—notably the use of vertical engines—tend to increase the labor requirements somewhat. The company is wisely doing all it can to add to its day load; its load-factor has now reached 27 per cent for the year and it is planned to increase the capacity of the station in the future by the addition of a low-pressure turbine equipment.

Plant 7, a station built on much the same lines as the preceding installation, produced electricity last year at a busbar net cost of $47,711, or 1.07 cents per unit. The station rating was 2000 kw, and the plant had three alternating-current generators driven by direct-connected, vertical, cross-compound engines of the condensing type and the same make as in station No. 6. The fuel consisted mainly of soft coal at $4.31 per ton, with about one-fourth as much coke at $3.50 per ton. The two largest items in the station expense were fuel, $30,009, or 0.67 cent per kw-hour, and station wages, $12,816, or 0.29 cent per kw-hour. The arrangement of the station equipment tended toward a relatively large payroll in reference to the size of the plant, there being the following men required: Four engineers, three oilers, three firemen and two helpers. The maximum load on the station was 1650 kw and the load-factor for the year was 31 per cent. The company produced 4,461,580 kw-hours during the year and sold 3,978,987 kw-hours. The motor service consumed 2,401,440 kw-hours. Five 250-hp water-tube boilers supplied the engines with steam at a pressure of 150 lb., and hand firing was used as in the larger station. The most striking difference in the operation of plants 6 and 7 appears in the cost of fuel per kw-hour. The smaller station is located in a city about 50 miles from the larger plant and all the fuel has to be hauled in the former case by rail. The lessened cost of tidewater coal handling in a station of similar design to that of an interior plant is significant. The plant with tidewater connections produced a 66 per cent larger output with an increase of but 13.3 per cent in the fuel bill. Something must, of course, be allowed for the superior efficiency of the engine equipment of the larger plant, but the main difference in fuel economy arises clearly from the lower initial cost of coal at tidewater in comparison with its price even two or three score of miles inside the seaboard. Both stations are intelligently operated by managements bent on expanding long-hour and off-peak business; and in each the percentage of energy sold in the year for electric-motor applications is at least sufficient to exert a real influence on the economy of station production. In fact, if the smaller station had had the advantage of the larger plant's fuel cost per ton delivered at the furnaces, it is a question if it would not have produced energy at precisely as high economy as the larger installation, since the 2000-kw station sold 60.5 per cent of its total energy marketed to motor users and the larger plant only 46 per cent.

Plant 8, the last of the group examined in connection with recent performance, is a new turbine station of 2500 kw rating which produced energy in 1910 at the rate of 0.99 cent per kw-hour, always bearing in mind that this figure makes no allowance of any character for fixed and distribution charges, general expenses and many other items of cost which must be considered if the rates of the company are taken up. The company generated 4,873,250 kw-hours during the year, sold 3,822,311 kw-hours and sold to motor users 961,207 kw-hours—a moderate day load, but one which has now begun to increase steadily under a new and progressive administration. The load-factor for the year was 28.4 per cent and the total cost of station operation, excluding fixed charges, was $48,158. The two largest items were fuel cost, $24,617, or 0.51 cent per kw-hour, and labor cost at the station, $12,255, or 0.25 cent per unit. The cost of coal was $3.33 per ton, with tidewater delivery at the station, and bituminous coal of good quality was

burned. Six water-tube boilers rated at 350 hp each supplied steam to the turbines, which are of the Curtis vertical type, rated at 500 kw and 1500 kw. The maximum load on the generating plant last year was 1960 kw. There is little doubt that as the rapidly growing motor service of this company has full opportunity to exert its influence upon the station economy the cost of production within the plant will decrease still further, unless an unprecedented rise in the price of coal occurs or occasion for unusual repairs arises. The company is gradually discontinuing the use of old equipment and is rearranging its distribution system to some extent. With the still heavier off-peak loads anticipated within the next few years the plant will be in a position to produce electricity under very favorable conditions.

ENERGY PRODUCTION COSTS OF EIGHT STATIONS.

Plant No.	Kw-Hours Manufactured at Bus.	Kw-Hours Sold to Motors.	Station Rating in Kilowatts.	COST IN CENTS PER KW-HOUR MANUFACTURED.			Yearly Load-Factor per Cent.	Approximate Fuel Cost per Ton.
				Fuel.	Labor.	Total.		
1	2,428,940	1,329,661	2,339	0.68	0.39	1.18	23.0	$3.90
2	8,079,038	2,507,232	3,000	0.56	0.29	0.89	33.3	4.27
3	5,513,034	1,482,424	3,400	0.54	0.25	1.05	32.0	3.99
4	2,089,200	111,596	1,400	0.57	0.30	1.07	20.0	3.86
5	4,357,648	3,636,390	2,435	0.78	0.22	1.15	26.0	3.94 3.17
6	7,344,392	3,027,476	5,200	0.42	0.30	0.94	27.0	3.57
7	4,461,580	2,401,440	2,000	0.67	0.29	1.07	31.0	4.31 3.50
8	4,873,250	961,207	2,500	0.51	0.25	0.99	28.4	3.33

The accompanying table summarizes the more important data of the foregoing plants.

These figures may fairly be said to represent the best commercial practice now obtaining in steam-driven central stations of medium size from year's end to year's end, with the price of coal ranging from about $3.50 to $4.30 per ton. They show that the cultivation of a large electric-motor load is most valuable in its effect on plant efficiency; that by extending the demand upon the machinery throughout many hours of the day, year in and year out, the station expenses per kw-hour delivered at the bus may be brought down to attractive figures, and that a large gross volume of business is much to be desired in its effect upon the power plant. A tabulation like the above can in no sense be used in determining *per se* the equity of rates, but it clearly shows that scientific management is bringing about significant economies in electric energy production.

CALCULATION FOR FLYWHEELS FOR PISTON-DRIVEN PRIME-MOVERS.

By George T. Hanchett.

THE energy delivered by a reciprocating engine to its crank disk is a periodically varying quantity, and for this reason a flywheel is required to make the revolutions approach uniformity. This it never actually accomplishes; it accumulates energy at increasing speed at times of high piston pressure and favorable crank position and returns it at diminished speed at times of reduced piston energy delivery.

The energy of the revolving mass is

$$\frac{a^2 I}{2g} = E_o$$

where a is the angular velocity, I is the moment of inertia and g the acceleration due to gravity.

If a flywheel has a certain permissible variation per revolution—that is, a certain allowable pulsation from a to a_1—the difference in the contained energies at the different speeds, that is to say, the give-and-take energy, is

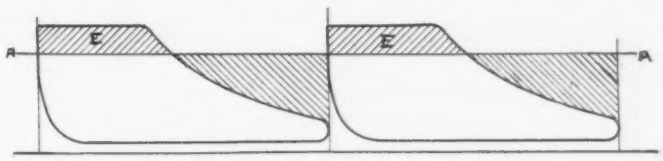
$$E = \frac{I}{2g}(a^2 - a_1^2)$$

The difference in angular velocity is usually fixed by specification, and, therefore, I must be great enough to make the entire expression represent a quantity of energy equal to that obtained above the average energy line.

The energy received by the crank is measured by the engine indicator card, and the energy line is, therefore, a plot of the indicator card, the back-pressure line corresponding to the horizontal axis. That portion of the diagram appearing above the mean effective pressure line *A A*, Fig. 1, represents the energy absorbed by the flywheel to be given out later when the energy supplied to the piston is below the average. This energy is shown as the shaded area in the diagram and may be determined by the planimeter. It is represented by the value E in the equation above.

If the engine has several cylinders the indicator cards appearing simultaneously must be superposed upon the diagram. It is necessary to combine them by adding together their simultaneous ordinates and producing a resultant curve, and then to determine the mean ordinate and draw in the line *A A*, whereupon the quantity of energy E may be determined by a planimeter, as before, and will be found to be a periodic time function.

The equations for representing the curves surrounding the engine indicator card are so complicated that the determination of the area by mathematical integration is much more laborious than the simple application of the familiar planimeter, which should always be used in this connection.



Cyclic Energy Diagram.

Transposing equation No. 1 there is obtained

$$I = \frac{E\,2g}{a^2 - a_1^2}$$

and if ρ is the assumed radius of gyration the weight of the wheel becomes

$$W = \frac{E\,2g}{\rho^2\,(a^2 - a_1^2)}$$

To apply this formula to a practical case suppose that the indicator cards have been combined and that E has been found to be 30 per cent of the energy of the indicator card. Assume further that the permissible pulsation or half revolution be 0.5 per cent and that the engine is a 1500-hp machine receiving 247,500 ft.-lb. per half revolution, which makes $E = 74{,}250$ ft.-lb. If the radius of gyration is 8 ft., a limiting radius for a cast-iron wheel at

a speed of 100 r.p.m., which speed will be assumed to be used, then

$$a^2 = (200\,\pi)^2 = 394{,}786 \div 3600$$
$$a_1^2 = (199\,\pi)^2 = 390{,}848 \div 3600$$
$$a^2 - a_1^2 = 3938 \div 3600$$
$$W = \frac{74{,}250 \times 2 \times 32.2 \times 3600}{64 \times 3938}$$
$$= 68{,}301 \text{ lb.}$$
$$= 34.1 \text{ tons.}$$

This is a very suitable weight of a flywheel for such an engine, although it is very heavy, because the engine is assumed to have only one simple cylinder.

STEAM "KINKS" AND SUGGESTIONS.

By Charles L. Kintner.

THE drip valves on a certain high-speed engine were set at an awkward angle, as illustrated in Fig. 1, the engineer deciding that the wheels could be reached more conveniently in this position than if the stems were at right angles to the cylinder. Fig. 2 illustrates a section of horizontal piping in another plant on which the stem of a globe valve is neither vertical nor horizontal, but half-way between these two; its appearance, therefore, is not symmetrical, as it does not harmonize with any of the pipes used in connection with it. There is a large valve in the vertical pipe, but the stem of it is neither parallel to the pipes above and below it nor at right angles to them. Both of these valves look as if they had been turned on the pipes until the screwed joints were apparently tight enough to prevent leakage and left without further consideration, unless the engineer thought that they were set in the most convenient position possible. Fig. 3 shows a Hancock inspirator with a globe valve about it. The stem of this valve is not set parallel to any part of the inspirator, neither is it at right angles to these parts. The only possible reason for this awkward-appearing position is that whoever set it up cared nothing for the way it looked so long as it "did the work."

Fig. 4 shows a steam pipe in front of a window, although it is not necessary for it to be located there. The longer vertical piece might have been set 12 in. or 15 in. toward the left hand without causing trouble elsewhere, and the horizontal piece with two tees could be lowered to a level with the window sill, thus leaving the window clear of all obstructions; but the designer evidently did not consider these points before the pipes were set up and the awkward appearance afterward apparently did not prove an outrage to his sense of harmony and beauty, as otherwise he would have remodeled the whole section, especially the vertical pipe which is not parallel to the window frame.

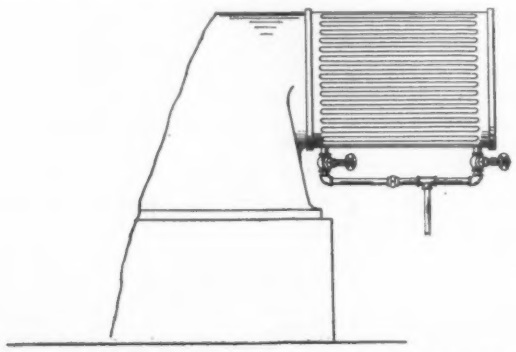


Fig. 1—Drip Valves on Cylinder of High-Speed Engine.

Fig. 5 illustrates something to be avoided on every convenient occasion. Here are two vertical pipes which ought to be parallel. The right-hand part consists of one pipe without a joint, while the left-hand part contains a tee and a union, requiring four screwed joints on which the threads are not properly cut; consequently the pipe as a unit is crooked in contrast with the straight pipe near it. As a general rule, two or more pipes ought not to be

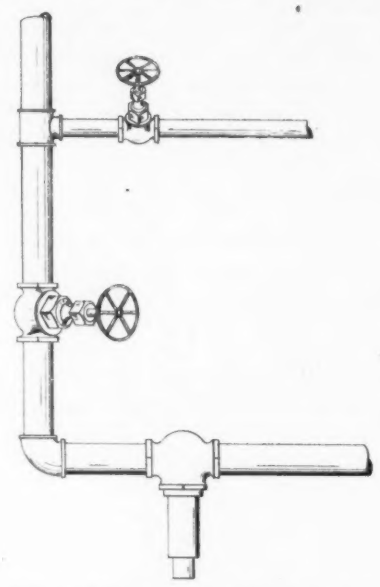


Fig. 2—Arrangement of Globe Valves on Horizontal Piping.

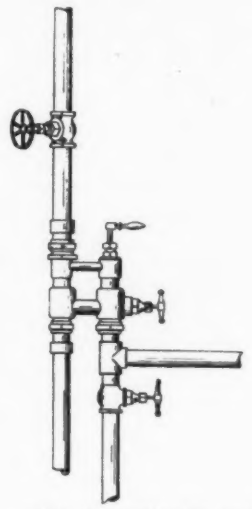


Fig. 3—Inspirator and Globe Valve.

located close to each other in a prominent place, as it is difficult to secure perfect alignment at all points. Unless the joints in a line of pipe are very poorly made in this respect they do not attract special attention, provided they are not brought into sharp contrast with something that is much more symmetrical. The above-mentioned defect is caused by lack of care in cutting threads or by imperfectly tapped fittings. The latter fault is difficult to remedy as fittings are usually tapped the full size for corresponding pipe and any effort to correct a bad thread results in making the fitting too large for the pipe. In the case of small fittings the best plan is to discard those that are defective in this respect, provided others can be secured which were not made in the same lot.

Fig. 6 is a pipe vise securely fastened to a suitable bench. It illustrates a "kink" whereby threads may be cut parallel

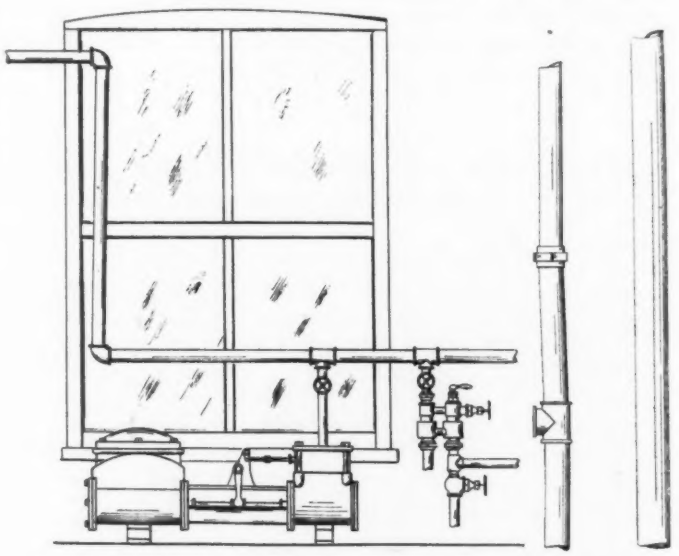


Fig. 4—Steam Pipe in Front of Window. Fig. 5—Crooked Pipe.

to the axis of the pipe, or, in more common words, it is a plan for cutting "straight threads." The bushing which forms a part of the thread-cutting stock is generally larger than the pipe on which threads are to be cut and therefore

perfect alignment of the dies is practically impossible unless thick paper (or something similar) is wound around the pipe until the bushing is a good working fit on it, as shown in the illustration at 2. If the stock is now put in

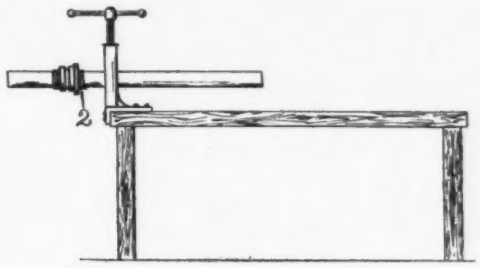


Fig. 6—Pipe Vise.

place over the bushing and fastened, it is ready for use and the resulting thread will make a straight joint.

Fig. 7 shows a very simple plan for testing the threads on certain kinds of fittings and nipples. One-half of a flange union 2 is laid on a metal face plate or a smooth bench. A bushing is screwed into it, followed by a nipple. If the upper end of this nipple "wabbles" when the bushing is turned it shows that a "crooked" thread was cut on one or more of the pieces tested. If a defective thread in the flange throws the nipple in one direction and an inferior bushing inclines it in another, it may be possible to cause one to offset the other, resulting in a straight joint for the combination complete.

Fig. 8 illustrates an application of the above-mentioned principle to a water column. The flange was placed on a level iron surface plate after a bushing was screwed into it as far as possible. It was then ground off on an emery wheel and hence it is not prominent in the illustration. This secures an extra strong flange, although selected from standard stock, because it is one size larger than the pipe. When the combination was placed as shown it did not stand plumb, but by holding the flange in a vise and applying a Stilson wrench to the water column the two joints were brought into different positions relatively, whereby the imperfection of one was offset by the other and the column stood plumb. The other half of this flange union was turned likewise until the face of it was level when standing in its proper place, so that when the two halves were bolted together the column stood plumb.

Fig. 9 illustrates the end of a pipe cut off by an ordinary wheel cutter. Fig. 10 is the same pipe after it is reamed out with the hollow, tapering pipe reamer shown in Fig. 12.

The engineer who set up the water column shown in

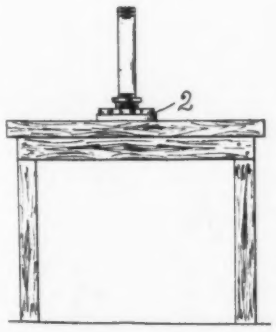


Fig. 7—Thread-Testing Device.

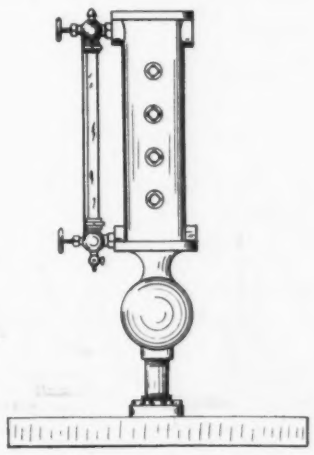


Fig. 8—Water Column.

Fig. 11 evidently believes that almost any kind of a piping job is good enough so long as it "does the work." The small-gage pipe 2 is not plumb, neither is the combination of valves and fittings at 3. The vertical piece 4 is too long, hence 5 pitches in the wrong direction, and as the latter is also too short it causes 6 to lean toward the brick setting instead of standing parallel to it. This illustration shows the condition of the piping in a small plant when a certain

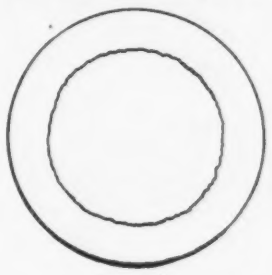


Fig. 9—Pipe Before Reaming.

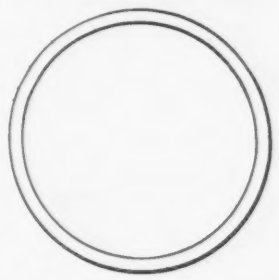


Fig. 10—Pipe After Reaming.

engineer took charge of it. As soon as possible he shortened some of the pipe, lengthened some more and straightened still more, until everybody, including the owners, could see the improvements made. The result was that he secured much better terms for operating the plant than were granted to his predecessors and he held the situation until offered a large increase in salary to go elsewhere—which he promptly accepted.

Fig. 13 illustrates a section of piping in a steam-power and heating plant. The wheel was used to operate a gate valve which admitted steam to the reducing valve below it. After passing this valve the piping is increased to 12 in. to supply one part of the heating system, to which steam is admitted in the morning and shut off at night. Of course, it is necessary to admit steam gradually under such conditions to avoid water hammer in the pipes, and the valve could therefore only be opened to a small part of its capacity until the cold air was expelled. Steam rushing through this small opening scored the valve and rendered it unfit for use.

It was taken out and a globe valve substituted, but inasmuch as this style is longer than a gate valve it was necessary to put in a valve one size smaller, with reducing flanges or else use close nipples with a valve corresponding to the pipes which it controlled. The engineer of this plant avoids the use of close nipples on every possible occasion because they are a source of weakness in any pipe

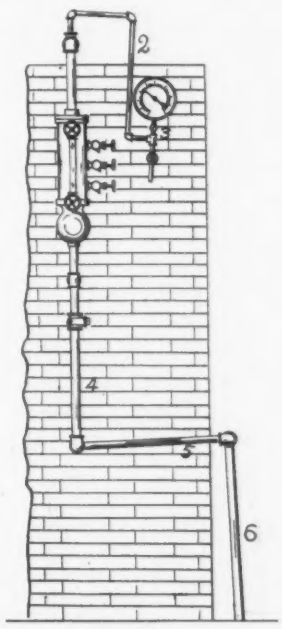


Fig. 11—Water Column on Boiler.

line and where used in connection with large fittings it is impossible to remedy a leak in the threads by means of calking.

Fig. 14 illustrates the job when completed. A globe

valve was adopted with a by-pass one-quarter of the diameter of the main valve. When turning on steam in the morning the by-pass valve is opened to about one-half of its capacity, which heats the cool pipes gradually, thus avoiding shocks and jars. It is then opened wider later on

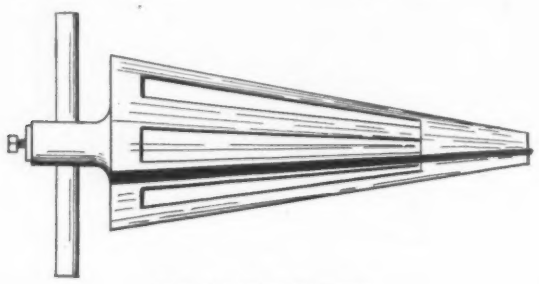


Fig. 12—Pipe Reamer.

until its full capacity is utilized, after which the large valve is opened and the small one closed. This prevents wiredrawing steam through the big valve and consequently it will last a long time and remain tight. Although the small valve may be damaged by the wiredrawing process repairs

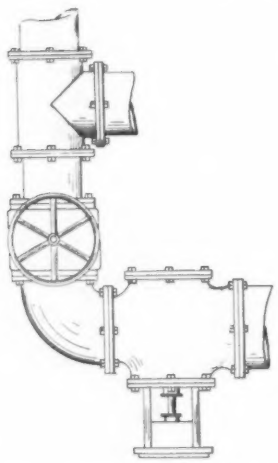


Fig. 13—Gate Valve and Reducing Valve.

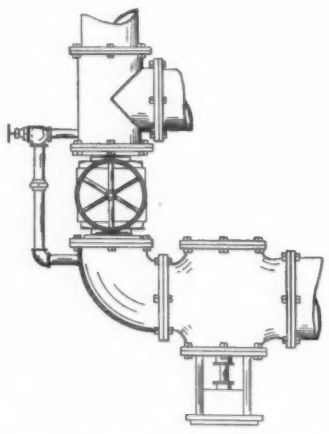


Fig. 14—By-passed Globe Valve When Completed.

to it will not be expensive. As a new by-pass valve will cost only $2 it can be renewed with much less trouble and expense than if required to refit a large gate valve or reseat and renew the disk in a globe valve. This new arrangement, therefore, becomes insurance of the larger valve at low cost and at the same time it provides much more satisfactory means of daily operation.

ELECTRIC FOUNTAIN USED FOR COOLING CONDENSING WATER.

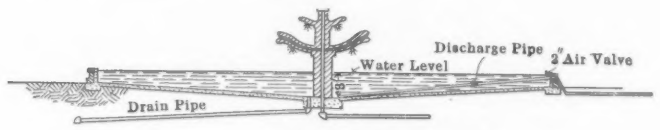
In planning a central ornamental feature for the attractive grounds of the Soldiers' Home near Los Angeles, Cal., the unusual combination of an electrically illuminated fountain and basin for cooling condensing water has been worked out. The fountain is to be erected on the lawn in front of the south entrance to the library building. This is about 1000 ft. from the power house which supplies the heat, electrical energy and water used in the grounds and buildings, and it is proposed to use the handsome fountain as a part of the system for cooling condensing water, thus uniting utility with ornamentation.

In all steam-condensing plants where there is a scarcity of water, with some difficulty in obtaining it from deep-well pumping, as is the case here, cooling apparatus with receiving basins and a circulatory system seems to be needed to reduce the operating expense. With this fact in view, and also in order to maintain the highest practical efficiency in the steam plant as economically as possible, it was decided to increase the cooling area for condensing water by the utilization of the basin of an ornamental fountain. A surface condenser is in use at present, but the cooling area is only about one-fourth of the requirements.

The change proposed will insure the condensation of all exhaust steam at the power plant and will also provide complete returns from the heating, cooking and laundry systems. At present only about one-third of the condensed steam from these utilities reaches the power plant owing to back pressure and the relatively high altitude of the power house, as well as the considerable distances to be traversed. It is estimated that when the new condensing system is in operation a saving of not less than 15 per cent in fuel consumption will be obtained. This saving will result about equally from the acquisition of pure, non-scaling water for boiler feed and better vacuum attained by improvement in the condensing system. The water in this locality is very hard and has rapid scale-forming characteristics.

To produce the cooling area required it would be necessary to provide either a several-stage cooling tower with a receiving basin and the necessary piping or some other equally efficient equipment for the cooling of condensing water. Fresh water obtained from wells will be used for this purpose, and will then be diverted into the general water-supply system after being cooled. This heating of the water and aeration of it in the fountain will also be beneficial in adding to the potable qualities of the water. The pipe lines connecting the fountain with the present power-house equipment will be about 1060 ft. long. The condenser in use is a 300-hp Worthington equipment with a full complement of pumps compounded on the steam end.

In view of these considerations it was decided to build



Fountain for Aerating Condensing Water.

a reinforced-concrete ornamental fountain, a cross-section of which is shown above. This fountain will serve as an additional cooling device. It is 60 ft. in diameter and is provided with a central metal pedestal 10 ft. high, surrounded by two smaller basins or lavers respectively 6 ft. and 12 ft. in diameter, supplied with ornamental spouts for the discharge of the water, which finally reaches the principal low-level basin. This fountain is equipped with the necessary piping for supplying and maintaining thirty-six jets of spray in various forms and dimensions, the sources of the water being an 8-in. supply pipe incased in the central pedestal, as shown in the cut. It is believed that providing a fountain in this manner will cost no more than the ordinary concrete-and-steel construction required for the purpose of cooling condensing water in the usual way.

The electric-lighting feature is simple, but will add much to the attractiveness of the fountain. Under each of the lavers or small upper basins are four pendent incandescent lamps, making eight in all, and the light from these shining through the falling water and spray will produce a pleasing effect.

The plan adopted for the fountain provides for an underground connection with the lighting system of the library building to supply the small amount of energy required. The wiring will be incased in 1½-in. iron conduit filled with asphalt. Sockets and receptacles will be embedded in the same material and the lamps will be inclosed in waterproof globes. Work is about to be begun on this unusual installation, and it is expected that the fountain will be in full operation some time in October of this year.

LETTERS ON PRACTICAL SUBJECTS

COMMUTATOR LUBRICATION.

All commutators do not require the same kind of treatment. It appears from experience that commutators on motors require the least care of all, there being days at a time when no attention need be given to them, followed by a slight greasing with an oiled cloth. Generators, on the other hand, are a more constant source of worry.

In a Tacoma substation a few years ago the writer while at work there noticed that one rotary at a time was always at rest and that every day all the brushes were removed and boiled in hot paraffine oil. The object, of course, was to render them self-lubricating, but at what sacrifice of time and labor! For there was really nothing gained by so doing, as the commutator was continually black with carbonized oil and required cleaning after closing down. The best method to use in this case would have been to obtain an entirely new set of best-grade graphite brushes and for lubricating purposes use a little vaseline applied with a piece of cheap muslin cloth. Excessive sparking would then denote that the remedy must be sought closer to its source, usually lying in truing the commutator or adjusting the spacing between the brushes.

Common machine oil is not satisfactory, as its body is too light and on a hot surface like the commutator soon carbonizes from the sparking and, in fact, causes a more vicious sparking. If used too liberally and frequently, the oil will soak into and rot out the mica between the bars, causing chattering of the brushes and ultimately ruining the insulating properties.

Vaseline applied with a clean cloth is the best all-round lubricator. It quickly dissolves and removes any blackening or gumming of the commutator, and this can be done while the machine is in operation. Chronic cases of black commutators, gumming and singing can be remedied with frequent applications of vaseline.

Seattle, Wash. CHARLES A. STARK.

THAWING A FROZEN PIPE BY ELECTRICITY.

Although the season for frozen pipes is past, the following may be of interest to readers who, in the coming winter, may find information on the subject useful.

Last winter the writer was called on to thaw out a 2-in. main in a distant part of a city. It was ascertained that a single-phase, 2300-volt line ran past the frozen main, and that a 30-kw transformer was available.

While looking around for some form of resistance or reactance it occurred to the writer that under the conditions nothing of this kind was needed and the following method was successfully carried out:

The line that ran past the frozen main was disconnected from the switchboard and connected to an idle alternator with an ammeter in circuit. The transformer was then hauled to the point where the pipe was frozen and connected up, the primaries being connected in the usual way and the secondaries spliced for their lowest voltage, which was 110 volts, and connected directly to the frozen main. The attendant at the power station was then communicated with and instructed to start up the alternator slowly (field excited) until the ammeter indicated 15 amp. It was expected that under the conditions the alternator would be running considerably under speed, but the attendant found that by keeping the exciting current low he could run at usual speed, thus keeping the frequency at its normal value. The primary voltage at the power house was 1800 volts. Twenty-four minutes sufficed to thaw the pipe, and this without reactances or resistances or trouble of any kind.

Ironwood, Mich. CHARLES SMEETH.

TAPPING AGAINST STEAM PRESSURE.

In spite of all precautions which can be taken there is more or less vibration of steam pipes, and pipes which connect oil cups with steam mains are no exception. It seems to the writer that it is a mistake to pipe any lubricator or oil cup under steam pressure with a pipe less than ½ in. in diameter. There are, however, many connections made of ⅜-in. and ¼-in. pipe and even ⅛-in. pipe has been observed in several instances. The danger of breakage is great where the connecting pipe is small and the strain exerted by a large wrench when removing the blocks or filling oil cups is often very severe, and many a pipe has been broken off at the bottom of the tread just where it enters the steam pipe from this cause. A break of this kind, especially when just above a large engine, is a very disagreeable incident, and when the engineer is obliged to let the steam escape for several hours or perhaps all night it is also expensive. Almost any pipe from ⅛ in. to ½ in. in diameter, when broken as above noted, may be closed against steam leakage by means of a wooden plug driven into the opening. Although this prevents the escape of steam it does not enable the engineer to lubricate the engine cylinder, and he may be forced to close down the engine unless he is lucky enough to have a compression grease cup on hand which can be used to force oil against boiler pressure. In two or three instances the writer has worked his way out of similar troubles by means of a pipe tap fitted to a common butt stock or carpenter's brace. In one of these instances a piece of heavy rubber cupping, such as is used for the valves of hand pumps used for removing water from excavations, was used to prevent the escaping steam from scalding the workman. A small hole was made in the middle of the diaphragm, the shank of the drill was forced through the hole in the diaphragm and then gripped by the bit stock. Behind the protecting shield of the diaphragm the workman was able to drill out a bit of broken pipe which remained in the hole in the large steam pipe. The drill was replaced in the brace by a pipe tap and the hole in the steam pipe was tapped to a full thread, after which a nipple and a valve and another nipple were made up and in turn put into the brace, and with that tool behind the protecting

Fig. 1—Pattern of Shield.

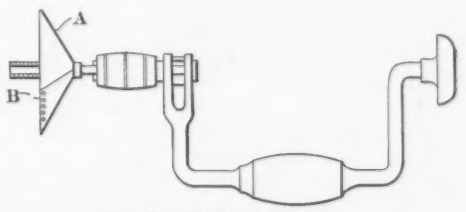


Fig. 2—Shielded Pipe Tap Fitted to Brace.

diaphragm one of the nipples was screwed into the pipe, effectually cutting off the escaping steam. Upon another occasion the convenient rubber diaphragm, with its 24 in. or more of diameter, was not to be found, and a piece of common tin was taken and a cone pattern cut out, as shown by Fig. 1. The pattern was made so that the cone would be very flat, at least 120 deg. Then several holes were punched around the circumference, as shown by Fig. 1. The tap or drill to be used was placed in the butt stock and a tin cone was applied, as shown at *A*, the edges of the cone being lapped over until the cone fitted very closely to the tap, after which a bit of wire was put through a couple of the holes, as shown at *B*, and twisted to hold the cone firmly in position. Nothing further was

necessary except to tap the hole and let the tin cone protect the workman. After doing one job with this cone the writer constructed three cones in a similar manner, so that one could be attached to the drill, the other to the tap, while the third cone was made to fit closely around the piece of pipe which was to be screwed into the opening. Broken oil cup connections had no more terrors for the engineers in that station, neither were they suffered to exist, for a new nipple would be inserted and the steam shut off by a newly connected oil cup.

Scranton, Pa. Tom Scott.

FAILURE AND REPAIR OF A SET OF DIRECT-CONNECTED ROTARY PUMPS.

The rotary pumps in question are located in a modern loft building using central-station service. Being located in the sub-basement, the pumps force water against a head 35 ft. over and above the actual height of the building. The designer of the plant seemed to think that pumping the water over the supply tank (which is located on the roof) was an easier task than to have the pumps discharge the water into the tank at its bottom, hence a greater amount of work was imposed on the pumps by increasing the pressure to be overcome, not taking into consideration the friction caused by the extra bends of the discharge pipe.

A most peculiar thing about the pumps was that both of them failed at the same time and from the same cause, although previously there was no indication of the pumps breaking down. When pump No. 1 broke down pump No. 2 was started and found to be out of order, thus depriving the tenants of water. Because of the large number of people employed in the building every attempt was made to start one of the pumps. The motors, however, "bucked" and the armature and field coils of one of the 15-hp motors were completely destroyed. The burned-out motor was replaced by a new one as quickly as possible, but this motor on being started came up to speed and when full speed was attained flashed over and blew the fuses. The new motor acting in the same way as the old ones indicated there was no trouble with the electrical equipment and all further attempt to start the pumps was abandoned. A small triplex pump was installed which partly supplied the necessary water and afforded an opportunity to investigate the cause of the failure of the other pumps. The company which installed the rotary pumps did not put in the motors and when it was called upon to explain why the pumps would not run it promptly placed the blame on the motors. The company which installed the motors was communicated with about the trouble and immediately sent two expert electricians to locate the difficulty. The motors were found in good order. The owner of the building, tired of waiting for water, decided to employ a pump expert. The latter advised rebabbitting the thrust bearings of both pumps, as shown at *T*, Fig. 1. When the babbitting was

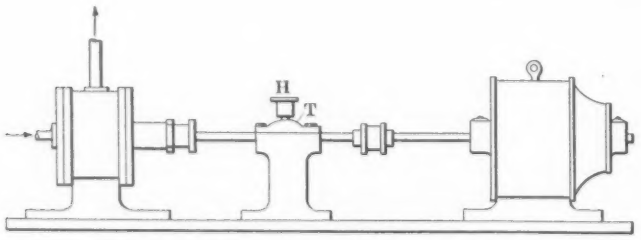


Fig. 1—Motor-Driven Rotary Pump.

completed the pumps were started, but the thrust bearings became overheated and the motors arced across the commutators and blew the fuses. The babbitting having failed to place the pumps in running order, the expert condemned the outfit and advised the installation of a triplex pumping outfit. When the new pump was started it was found to be too small to supply the required quantity of water. This difficulty was partially overcome by having a portion of the building receive its water direct from the street mains and having the pump supply water for the upper

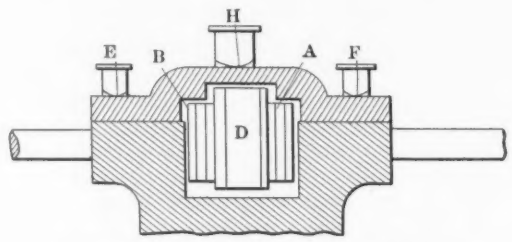


Fig. 2—Arangement of Thrust Bearing.

floors of the building. The installation of the new pump gave time to discuss the failure of the pumps and the best means to effect their repair. It was decided to try to put the pumps in working order without the assistance of outside help or advice. One of the first suggestions was to cut out the babbitt from the thrust pockets and insert papier-maché washers on both of the sides of the thrust collar.

The motors then came up to speed and worked without flashing across the commutator, but the excessive load on the motors, the heating of the bearings and rapid wear of washers presented difficulties. The papier-maché washers were then taken out and the propeller and motor shaft moved longitudinally from one extreme to the other. This disclosed the fact that the propeller at either extreme would bind on the pump heads, thus causing the excessive load on the motors. This discovery quickly led to a plan for equalizing the longitudinal travel of the propeller so as to prevent any further trouble from excessive friction. The propeller and shaft were moved to the extreme left and this point was marked, then the propeller and shaft were moved to their extreme travel to the right and this position was also marked. It was argued that if the thrust collar were made to rotate centrally between these two marks it would cause the propeller to "float" between the pump heads and hence it would be impossible for it to cause friction. Brass washers were placed on both sides of the thrust collar *D*, as shown in Fig. 2, at *A* and *B*. When all was ready the pumps were started and found to work nicely. After a few weeks' running it was discovered that the brass washers at *B* (which are the washers to sustain the thrust when the pump is working) wore away, and hard-steel washers were substituted and found to give better results with respect to wear, but some heat would develop, which was not desirable. Thin steel washers having a brass washer centrally located between them were then inserted and were found to be satisfactory. The object of displacing thick steel washers by thinner washers was to allow the bearing to assume the function of a ball bearing. Placing a brass washer between an equal number of thin steel washers prevented the hard washers from cutting the thrust collar. The manufacturer of the pumps only supplied the bearings with one oil cup, as shown at *H*, but two other cups were added, as shown at *E*, *F*, with excellent results.

New York City. William Kavanagh.

SPECIAL CEILING SURFACES FOR INDIRECT LIGHTING.

A recent accomplishment of the moving-picture folk in improving the reflecting efficiency of their projection screens should offer a useful hint to those designing installations of indirect lighting. Having brought the intensity of the arc and the projecting machine up to its practical limit, the moving-picture men next attacked the prob-

lem of increasing the brilliancy of their pictures from the screen end, seeking a material of higher reflecting power than the ordinary sheeting commonly used. A picture thrown on canvas can, as is well known, be seen about equally well from the rear of the screen and from the lantern side, indicating at once an efficiency of only 50 per cent in either direction. If part or all of these rays absorbed and passing on through the sheet could be returned on but the single useful side, the illumination of the picture would obviously be much increased. This result has recently been accomplished in the production of an improved screen, heralded on the billboards of the 5-cent theaters as an "incandescent curtain," but really only a prepared surface of higher reflecting power than the ordinary white screen. The results are surprising, the pictures being far more brilliant and, as a result thereof, more free from flicker.

The indirect-lighting art has now reached the same limitation. Employing reflectors and lamps of the highest efficiency, the over-all results are yet tremendously reduced by the poor reflective coefficient of ceilings and walls. The character and tint of the coating applied to these surfaces where indirect illumination is to be used should be specified by the illuminating engineer as a part of the lighting system and not left to the judgment of architect, owner or painter, whose selection is made without knowledge of the duty of the ceiling as a reflector. There is no doubt that, following along the work of the moving-picture screen mentioned, special paints could be developed having albedoes or reflective coefficients much higher than those in use. With such paints and more of the light returning to the room and less entering the walls the present excessive wattage required with indirect lighting (about two to one compared with direct illumination) might be substantially reduced and the physiological comforts of this system of lighting be more generally secured.

Chicago, Ill. G. B. COLLIER.

OHMIC AND INDUCTIVE RESISTANCES OF METER-CURRENT CIRCUITS.

In measuring electrical energy by a watt-hour meter there are certain sources of error which are commonly neglected, especially where the block of energy being measured is small. The errors referred to are those known as ratio errors and phase errors of series-instrument transformers and also of shunt-instrument transformers feeding the meter circuit in question. The ratio and phase errors of a series transformer are dependent upon the ohmic and the inductive resistances of the meter series circuit fed and upon the percentage of full-load current at which the series transformer is operating. Hence the accurate current ratio of a series transformer cannot be given except for given conditions. These errors frequently exceed 1 per cent of the rated full-load amperage of the transformer, and where large blocks of energy are being measured the correction for these errors will soon more than pay for the trouble and expense of such determination and correction. A method has been published of determining these errors in the case of a series transformer for any given ohmic and inductive resistance of circuit to be fed, and an outline will be given below of a novel method of measuring the ohmic and inductive resistances of a given meter circuit (which is to be fed by the series transformer) in order that the operating conditions may be imposed upon the transformer while under test. The inconvenience and expense of ordinary methods of determining series circuit constants and of running ratio tests under specific conditions often stand in the way of making the necessary corrections for errors that exist. The following method of measuring the above circuit constants requires no source of direct current, but uses the polyphase emf supply which feeds the meter. Several amperes can be drawn from the secondary of a shunt-instrument transformer for a minute or so without running any risk of damaging the transformer. The method consists, in short, of measuring upon a wattmeter the reaction between a certain voltage drop *A-B*, Fig. 1,

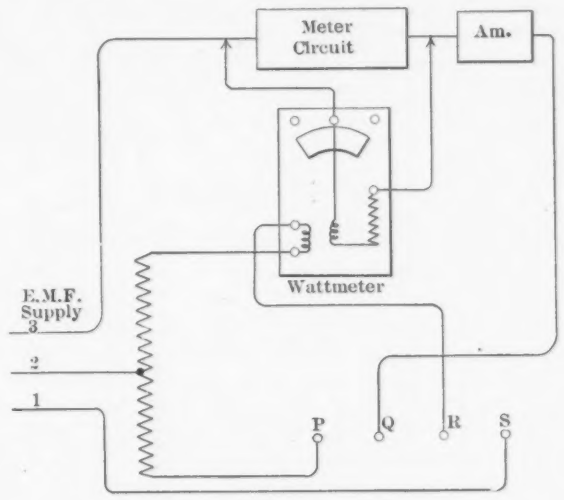


Fig. 1—Diagram of Connections.

and a certain current fed from phases 2-3 through ohmic resistance, and again measuring the reaction between the same voltage drop and the current fed from phase 1-2. The case described is as supplied to an available three-phase emf supply 1-2-3, but the method is easily applicable to other polyphase circuits. In diagram Fig. 1 *P*, *Q*, *R* and *S* are nails driven in a board and connected as shown. The rest of the apparatus shown is self-explanatory. When a jumper is placed from *Q* to *R* it will be seen that current is fed through the series coil of the wattmeter and through the meter circuit to be measured. Now the component of the voltage drop *AB* which is in step with the current will cause the wattmeter to deflect. For example, if the reading is, say, 28 watts and if the amperage is, say, 6, then the ohmic component of the drop *A-B* is 28÷6=4.66 volts and the ohmic resistance from *A* to *B* is 4.66÷6=0.78 ohm. Now remove jumper *Q-R* and place jumpers on *P-Q* and on *R-S*, thus keeping the same current in meter circuit, but changing the phase of the current in the wattmeter series coil. The watt reading now is, say, 42. In diagram Fig. 2 the angle 3-2-1 is 60 deg., representing the two phases of the current against which the voltage drop *A-B* was caused to react in the wattmeter. The distance 2-*X* is

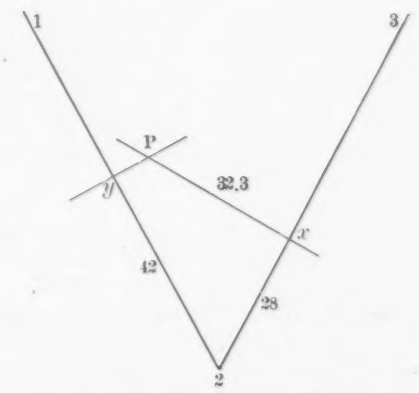


Fig. 2—Graphic Solution of Problem.

plotted to some scale equal to twenty-eight divisions, and the distance 2-*y* is plotted equal to forty-two divisions, as per above readings. Perpendiculars are erected as shown at *X* and *y* and their intersection at *P* is the end point of the vector 2-*P*, which represents the voltage drop *A-B*,

and 2-X is the ohmic component and X-P is the inductive component. Scaling off X-P to the same scale it is found to be 32.3 divisions or "inductive watts." Then the inductive volts are $32.3 \div 6 = 5.38$ volts and the inductive resistance is $5.38 \div 6 = 0.9$ ohm. The apparatus required for the above measurements will be seen to be simple and the values of resistances obtained are reliable within a few per cent, which is sufficiently accurate for the purpose in hand, as the total effect of the resistance upon the ratio of the series-instrument transformer is in general under 2 per cent.

Niagara Falls, Ont. H. S. Baker.

INSPECTION DURING ERECTION OF CONCRETE FOUNDATIONS.

The writer has had brought home to him very strongly the utter absurdity of some of the concrete work constantly being done for foundations of electrical machinery and station buildings. Many of the contractors have learned their lesson and realize what it means to concrete work that it be made and placed properly. But there are still very many makers of concrete who seem to be actuated only by the principle that a certain space is to be filled with concrete as cheaply and as quickly as possible, and, seemingly, they proceed as if it made no difference how, where or when the content of cement was added to the mass of aggregate. The above statement is inspired by the recent work of a contractor who, being detected in underproportioning cement by the engineer, proceeded to put in very rich layers of concrete—rich in cement beyond all use or requirements, and thus proceeded until he had added the amount of cement necessary to bring the amount contained in the entire foundation up to the required proportion. The inspection of concrete should commence, not in the mixer, but with the material itself and before it is dumped from car or cart. The cement if from a well-established manufacturer may be accepted as being properly made, but its physical condition should be looked to closely. One should make sure that the cement has not been wet sufficiently to cause it to cake in the sacks, because cement once set, even though partially, and therefore full of lumps, cannot make as good work as fresh, dry cement which does not contain enough water to cause lumps. The sand and the broken stone or gravel should also receive close attention. Good gravel is preferable and makes better concrete with less labor than sand and crushed rock. The inspection should determine and fix the amount of cement used. This should not be an arbitrary proportion fixed by the architect, but should be determined by the inspector upon the ground, and it should depend upon the material being used. Furthermore, the necessary proportions of cement and gravel may vary with each lot of gravel used. This is not detrimental to the interests of the contractor, for it is only necessary to provide material which shall make concrete with 1500-lb. crushing strength per square inch. It is possible to do this by properly grading ordinary sand and gravel with only 6 per cent of cement. It all depends upon the grading and the closeness of the mixture to the curve of greatest density. Thus it is for the interests of the contractor to grade aggregate very closely. When it is not practical to grade (which is the separation of the gravel into four or five sizes and then recombining them) a very close approximation may be made by rectifying the gravel. Rectifying consists of adding a portion of one or more other kinds of material as tests show it to be beneficial. Usually it is found that too much fine material is present in the gravel. Then the concrete may be improved by adding some coarse gravel or crushed stone. In other cases some very fine sand is needed, and the material is "rectified" by adding certain percentages of one or both, as may be found necessary by a test with the sieves or by the cubical box and water percentage method. After a satisfactory aggregate has been provided the inspector should see that the water is of good quality and free from dirt, grease or acids. The latter are very detrimental to concrete. The proper amount of water should be used in mixing the concrete, such an amount as will barely show on the surface after the concrete has been tamped. In depositing the concrete in place it should not be rolled down a long incline or spout in small quantities. So doing will surely separate the large material from the smaller particles. Rolling the concrete down the edge of a large pile of material has a similar effect. The best way to get concrete in place is to dump it where wanted, either by an improved bottom-discharge car or skip, or by dumping the concrete from a shovel or from a wheelbarrow directly into the place where it is to be rammed. This being done, and the ramming well performed, the inspector may be assured of good concrete as far as the placing is concerned. Too much concrete should not be dumped in without ramming. It will not secure good results to tamp upon the top of a 2-ft. depth of loose concrete. The top of the pile will be made hard, but there will be soft places in the center of the mass or at the bottom which surface tamping cannot reach. A small pinch-bar is a most excellent tool for the inspector to use while testing the placing and ramming of concrete. That tool will enable the inspector to locate and detect soft pockets of concrete and he should see that such defects are remedied at once, for they are fatal to the strength of concrete. The aggregate should be kept evenly distributed in the concrete and large pebbles should not be allowed to collect at one point while sand and cement are in force somewhere else. The concrete should be deposited and tamped at once—immediatly after it is mixed—for it is very detrimental to concrete to allow the mixed material to lie until the initial set has taken place. The removal of forms should be closely watched by the concrete inspector. Where conditions are such that some portions of the concrete mass must carry considerable of the weight of the concrete itself, then the forms should not be removed for a week or ten days. In other cases they may be removed as soon as initial set has taken place. This is the case with footings and similar work which are to be buried in earth. The quicker forms are removed from exposed work the more sprinkling of the finished concrete must be done, for it must be kept moist or it will not harden. Concrete will cure or harden perfectly without any sprinkling whatever provided the necessary amount of water is added during the mixing of the material, as described above—and that the water is kept in the concrete after it is rammed. This means that none must be lost by evaporation, hence the desirability of keeping the forms in place as long as convenient and also covering the concrete, after forms have been removed, with earth, sawdust, sacking (wet) or any substance which will prevent evaporation. Failing in any of these the inspector must insist upon the surface of the concrete being kept in a moist condition by frequent sprinklings. When the foundations are complete the inspector must exercise judgment in permitting the loading thereof until two or three weeks have elapsed after ramming. Concrete does not come to good strength until it has been kept moist and unfrozen for twenty-eight days, and even then cold has an effect upon it compared with the speed of hardening in hot weather. The inspector must be fair to the contractor as well as to the owner, and therefore he must see that the foundations are allowed to remain unloaded until they are ready for use without danger of cracking. The inspector may permit the gradual loading of the foundations as their aging progresses, but should exercise care in the interests of the contractor to insure that green foundations are not damaged by the careless handling of machinery.

South Bend, Ind. James F. Hobart.

QUESTIONS AND ANSWERS

In applying for a United States patent for an electrically operated water meter will it be necessary for me to prepare drawings or can I submit the model which I have already built and operated successfully? G. E. H.

The invention should be illustrated by means of a drawing and described with such clearness that a person skilled in the art to which it pertains can construct and operate the device. The strength of the patent lies wholly in the claims, and the patent when issued will be worthless or valuable according to the wording of the claims. The preparation of the application and wording of the claims can best be done by a reliable attorney familiar with such work rather than by an inventor without experience along this line.

Wherein does the split-pole converter differ from the standard synchronous converter? H. L. O.

In the standard synchronous converter the ratio of the direct-current voltage to the alternating-current voltage is practically constant. Where it is desired to vary the direct-current voltage it is customary to employ induction regulators or alternating-current boosters or voltage-varying dial switches connected to taps in the transformer windings. In railway work it is usual to employ series reactance and to vary the wattless component with the load, thus varying the delivered alternating-current voltage and consequently the direct-current voltage at the expense of a varying power-factor. The split-pole converter gives a means of varying the ratio of the direct-current voltage to the alternating-current voltage by varying the magnetic field distribution only, thus doing the work of induction regulator, booster or other voltage-varying device. The only voltage-varying device external to the converter is an additional field rheostat or other field-controlling device which may be operated manually or automatically. In the latter case a compound winding responsive to the load may be used or automatic regulators responsive to voltage. Split-pole converters are not built except for 25-cycle circuits.

We have a 600-volt, 500-kw, direct-current, six-pole, compound-wound, interpole railway generator, directly connected to a 2200-volt induction motor. This set runs in parallel with another set, identically the same in every way, situated in another substation about 10 miles away. The direct-current circuit-breaker belonging to the machine in question is set at 1000 amp, which is 20 per cent overload. Some months ago it was noticed that the brushes sparked considerably at a great deal less than full load. This sparking gradually grew worse, till the brushes sparked a little at even no load, and sparked badly at full load. The brushes were kept perfectly clean, and the commutator was cleaned daily after shutting down in addition to a vigorous wiping off during the day. Only a very small quantity of oil was used to lubricate the commutator and everything else was done that could be thought of to reduce the sparking, but without avail. The brushes were set and are still set at the point indicated by the manufacturer (very slightly back of the center of the shunt-field poles). They are set at exactly the same point as are the brushes of the other duplicate machine mentioned above, which has always commutated perfectly. By way of experiment the brushes have been shifted forward and backward a short distance a number of times, but this had no effect in reducing sparking. A short time after the sparking was first noticed, it was discovered that at three points on the commutator, 120 deg. apart, the commutator bars were burnt and roughened for a distance of little greater than the thickness of the brushes; that is, about two and one-half bars were roughened their entire length at each of three points 120 deg. apart. This condition continued and spread to the adjacent bars in spite of all that was done to prevent it. The coils attached to these bars showed no excessive heating nor anything, in fact, to indicate a defect of any kind. The entire armature winding seemed perfect in every way. Soon high mica showed up at a number of points (both where the bars were burnt and at other places). The commutator was ground down by holding scythe stones carefully by hand against it. This was the only method available at the time. The result was a smooth commutator, no high mica and everything apparently as it should be. The brushes were then carefully sandpapered to fit the commutator. For the first six hours or so commutation was sparkless and hope was entertained that the difficulty was overcome, but within twenty-four hours the same old trouble had reappeared and steadily grew worse. The negative brushes arced much more than the positive and the negative brush-holder arm which was at the top of the commutator, that is, the point of the commutator farthest from the floor, arced worse than the other two negative holders. The spacing of the brush holders around the commutator was checked and found to be correct. Then the brushes began to chatter badly and no adjustment of the brush-holder spring would remedy this. The commutator was evidently not true and arrangements were made to turn it down. After this was done and the machine put into operation again commutation was perfect for a day or two, from no load up to the opening of the breaker. The opening of the breaker due to overload occurs on an average of from five to forty times a day. Then it was noticed that the same bars 120 deg. apart began to show signs of burning as before the turning. Sparking showed itself at about half load and grew worse. The positive brush holder first ahead of the negative holder at the top of the commutator sparked the worst. The negative brushes sparked very little. The brushes in this positive holder spit and arc viciously at about two-thirds load. This holder is spaced absolutely correctly, as it has been checked several times. The brushes are sandpapered daily and carefully wiped and cleaned. By a daily heroic use of sandpaper on the commutator its surface is kept fairly smooth and the burnt bars are kept down. Two hours spent every morning before the machine is thrown on the line and while the commutator is cold produce a surface which shows but the barest trace of burnt bars in a few spots. Sparing use of good oil for lubrication, constant wiping during the day and the occasional use of coal-oil on a rag to clean off carbon dust (which will come off in no other way) produce upon shutting down at night a commutator darkly stained and with certain bars badly burnt (always the same bars). The brushes, by the way, are the regular brushes furnished by the manufacturer for this equipment. We have considered the possibility of a shorted coil and an open one, but neither of these fit the conditions exactly. An open coil shold arc on no load and a shorted coil should heat up, neither of which things occurs. If you can suggest a possible cause for our trouble or offer a remedy as yet untried you will confer a great favor. A. D. M.

You will appreciate the fact that it would be practically impossible for a person in New York to form an adequate opinion as to the causes of trouble in a machine in Portland, Ore., when the person who outlines the causes as he sees them in Portland is unable himself to locate the trouble. It is evident, however, that the two machines mentioned by you are not identical in every respect or are not operated identically. It is very probable that the former rather than the latter covers the facts. That is to say, the machine which causes trouble differs in some respect from the machine which causes no trouble. Taking into consideration all of the facts mentioned by you, it would seem that the magnetic circuits of one machine are not properly balanced. That is to say, the three pairs of poles are not spaced magnetically 120 mechanical degrees around the air-gap. If this is the case, troubles such as you describe would exist. We suggest that each brush around the commutator be insulated completely from its holder and from the outside circuit. When the machine is separately excited, or excited by means of one positive and one negative brush, the voltage between any positive and any negative brush should reach its proper value and there should be no resultant emf between the three positive brushes and no resultant emf between the three negative brushes. Unless our guess is incorrect, which is not at all improbable, you will find a considerable voltage between the brushes which should be at equal potential. Such an emf would produce a circulating current at all loads, as may be observed by connecting the brushes together through an ammeter, but the sparking might not become evident except under considerable load, or after the commutator had gradually become roughened. If an examination reveals an emf the trouble caused thereby may be minimized by shifting the individual brushes of each polarity until the emf disappears. The proper positions can be found by means of a low-reading voltmeter and the necessary shifting can be done by changing the brush holders or it can be accomplished by means of properly trimming the brushes.

Central Station
Management, Policies and Commercial Methods

FREE FAN SERVICE FOR THE SICK.

The San Diego Consolidated Gas & Electric Company, San Diego, Cal., has addressed a communication to the daily press of that city announcing that during the remainder of the summer the company will place without charge electric-fan service at the disposal of every sick person who is unable to pay for the fan and service and whose sickroom can be reached from present distributing lines. The conditions are that the attending physician shall certify in writing to the desirability of fan service from a medical standpoint and to the financial inability of the patient, and shall also notify the company when the necessity for the service has ceased. If the house is not wired the company offers to run service wires and install sufficient interior wiring to operate the fan, loaning the latter as long as may be necessary.

DEDICATION OF CLUSTER LIGHTING.

Farmer City, Ill., made the commencement of cluster street lighting an occasion for a celebration that attracted to it a number of visitors from neighboring towns and the surrounding country exceeding several times the population of the town. The local band paraded the town and an orchestra furnished music from a platform erected in the main street, while a neighboring platform was given over to singing and acrobatic dancing. The storekeepers had their windows specially decorated, one showing portraits of the mayor who commenced the electric-lighting system, another of the mayor who completed it, and a third of the chairman of the Council electric-light committee. Other features consisted of wheelbarrow, one-legged, fat men's and other races, greased-pole climbing, tug-of-war, pie-eating contest, parade in costume and a dive from a high building to a net stretched in the street below. The local paper, which pronounced the dedication of cluster lighting a success of which the community should be proud, does not, however, mention the street lighting beyond saying that it was the occasion of the celebration.

WIRING REGULATIONS IN DENVER.

Under a new Denver electrical ordinance the published rules of the city electrician become a part of the ordinance. Under Mr. Joseph F. Reardon, who has held that position for seven years, a remarkable advance in electrical construction methods has taken place in Denver. Conduit is now required in new and rewired work in all classes of buildings throughout the city. Signs are required to be of entirely non-combustible material. The rewiring of old installations is far more frequent than is usual in Eastern cities, and the public's attitude toward the better wiring construction is unusually favorable.

Recently twenty inspectors of the Denver Gas & Electric Company, under the supervision of Mr. Reardon, covered every building in the city, noting particularly the use of brass-shell sockets in kitchens, baths, toilets, basements and similar locations. Upon receipt of their reports the city electrician issued warnings of the personal hazard involved and asked for the removal of such sockets from the reach of the public or their replacement by porcelain sockets. Within a short period over 90 per cent have been replaced by building owners or occupants, only about 1 per cent refusing.

A new rule for alternating-current motor fusing has just been made effective requiring three-phase, 220-volt motor circuits to be figured at 3 amp per horse-power per phase. Running fuses must be of a size to protect this size of wire, but starting fuses may be 25 per cent greater up to 50-hp motors, and 50 per cent greater for motors above 50 hp. It is anticipated that much difficulty arising from conflicting sizes of motor feeders as figured by different competing contractors will be avoided and feeders never be reduced to unsafe sizes. No. 12 wire is the minimum size allowable for motor feeds.

ELECTRICITY IN A COLORADO HOTEL.

Electric lighting and motor service play a prominent part in the operation of the Antlers Hotel, at Colorado Springs, Col. Energy for motors and lamps is supplied by the Colorado Springs Light, Heat & Power Company through an underground transformer and switchroom, the motor service being wired for 550 volts direct current, the lighting distribution being by 110 volts alternating current supplied on the two-wire system. Three 15-kw transformers are installed for the lighting service, the primary leads being connected to the 2300-volt circuits of the central-station company. A two-panel lighting switchboard is in service, nine main lighting switches being installed. Seven electric-power circuits are in operation, and the energy consumption of the hotel is measured by four recording wattmeters. About 28,600 kw-hours per month is consumed by the hotel.

The motor service is handled by about twenty-one motors, ranging in size from ⅛ hp to 25 hp. Included in the equipment are an ice-cake cutter, driven by a ½-hp motor; an 18-ton duplex, double-acting Carbondale refrigerating machine, driven by a 25-hp motor; a 10-hp vacuum cleaner, 5-hp brine pump, 3½-hp triplex water-service pump and numerous fans. In the hotel laundry washers, extractors and body ironers are group-driven by a 25-hp motor, and a 10-hp mangle is also in service. Seven 6-lb. electric irons are in use in the laundry, and two 15-lb. irons are in service in the tailor shop. Three elevators are driven by motors aggregating 40 hp; menu cards and other stationery are printed on a private press, driven by a ½-hp motor, and motors of the latter size are employed in driving polishers and buffers in the silver closet, a kitchen fan and 26-in. ventilating fans in the dining room, office and parlor. A ⅛-hp motor operates a pump in connection with an electric fountain used at banquets. In the bakeshop a 3-hp motor operates an ice crusher and ice-cream freezer, the freezing process being handled by brine, instead of ice.

All guestrooms are lighted by from three to four tungsten lamps of the 25-watt size, and in the kitchen an arc-lighting installation is in service. An extensive telephone equipment is in service in the hotel. A prominent feature of the hotel service is an elaborate Turkish-bath establishment, in which two electric heating cabinets, an electric tub, blanket and equipment for the application of various high-frequency currents to the body are in service. The principal electric cabinet contains fifty-six lamps of 16-cp rating, with bulbs giving a graduated ray, including red, violet, yellow and orange light. Experience shows that with the electric cabinet a temperature of 100 deg. Fahr. can be attained in 7 minutes, while with the ordinary steam cabinet at least 15 minutes is required. The comfort of

the electric cabinet is also much greater than that of the steam equipment. Medical experts estimate that from 7 per cent to 8 per cent more carbon dioxide is eliminated from the blood with the electric cabinet. An extensive equipment of electric vibrators is in service at the "Antlers," and in the main lavatory antiseptic conditions are maintained by a 110-volt Vohr motor-driven ozonator. All the steam-heating service of the hotel is supplied by the Colorado Springs Light, Heat & Power Company.

A NOVEL LOAD DISPATCHER'S RECORD BOARD.

A new record board recently installed in the office of the load dispatcher of the Edison Illuminating Company of Detroit makes use of several hundred miniature knife switches to represent the actual arrangement of the oil switches in the various stations operated under the dispatcher's direction. The circuits and bus arrangements of the generating stations and substations are all faithfully reproduced on the miniature board, and when the dispatcher orders a switch opened or closed he records the change on the miniature counterpart of the system. All machine switches, trunk-line switches, tie switches, etc., are shown, although some of the feeder switches have been omitted where these are normally closed unless out on overload. For several stations even the hook-type disconnect switches are reproduced by miniature hook switches, when these switches play a part in transferring or rerouting circuits. For this purpose the Detroit Edison Company also makes use of jumpers and plugs having carrying capacities equivalent to the regular bus and cable cross-section. These actual jacks and jumpers are reproduced by miniature jacks and U-shaped jumpers on the record board so that all transfers of circuits can be duplicated. When work is being done on a circuit, the corresponding switch is opened on the dispatcher's order and tagged with a red warning card. At the same time a similar tag is attached to the dispatcher's little switch, guarding him against ordering this switch closed until he has received word from the man doing the work that the line is clear. Under no conditions can any switch on the system be manipulated without the dispatcher's instruction.

The record board thus gives at all times a graphic reproduction of the system's arrangement, and the use of small switches which are actually thrown into position has been found to be much simpler and clearer than an adaptation of painted switches, plugs, etc. The little switch-blades used are of about the size of the smallest porcelain mounted knife switch in use on 110 volts, and more than 200 of these tiny blades are employed in the duplication of the Detroit company's system. Generators, transformers and other apparatus are indicated by the usual symbols, cables by black lines, and the main buses by copper strips. Mr. J. Bishop is chief operating engineer for the Detroit Edison Company.

MUNICIPAL PLANT AT NAPANEE, ONTARIO, SOLD TO TOWN'S ADVANTAGE.

On July 25 the town of Napanee, Ontario, passed a power by-law by a vote of 408 to 46 disposing of the municipal electric-light plant to the Seymour Power & Electric Company, Ltd., of Campbellford, Ont. The plant, which was installed in 1906, contains two 125-kw, 60-cycle, two-phase generators, each of which is belted to a high-speed engine. The apparatus is housed in a substantial stone building with concrete floor and roof and the street-lighting equipment consists of two 25-light regulators with a mixed system of series inclosed arc and 80-watt series tungsten lamps. The entire plant is in first-class condition, having been constructed in a thorough and workmanlike manner in the first place and afterward well maintained.

In selling out to the Seymour Power & Electric Company the town of Napanee secures a twenty-four-hour service instead of a dusk-to-dawn service which previously obtained. Moreover, the change will be accompanied by a substantial reduction in rates. The street arcs, for each of which the plant was credited with or received $70 per annum, will hereafter be maintained at a yearly rate of $55. The series tungsten lamps used for street lighting will be reduced in cost from $20 each to $15 each per year. The commercial and residence lighting schedule of rates will be reduced from 10 cents per kw-hour to 8 cents per kw-hour and meter rentals will be abolished. For those who desire it there will be an alternative rate for residence lighting of 10 cents a room per month plus 3 cents per kw-hour for the energy consumed. This rate is somewhat similar to that of the Hydroelectric Commission in Toronto. The rates for energy used by motors will not exceed $25 per hp-year for twenty-four-hour service.

From the above it is evident that the town has been benefited by the sale, and the new rates should result in the expansion of industries now in the town and the acquisition of other industries. The Seymour Power Company's 44,000-volt transmission line is now complete as far as Deseronto and will be extended to Napanee, where a substation will be erected in order to make the necessary delivery of energy. The energy can be delivered from the company's stations at Campbellford or Trenton, so that the duplicate sources of supply will insure a reliable service at all times.

OPERATING COST OF A GAS-PRODUCER CENTRAL STATION.

The operating experiences of small central stations often indicate the direction in which betterments can profitably be made. Close figuring is generally necessary to turn the income into an annual profit and the importance of pushing the commercial development of the small company can hardly be exaggerated. A typical instance is furnished by a central station of 75-kw rating established not long ago in a town of the farther West. The plant consisted of a 2300-volt, three-phase, 60-cycle Westinghouse alternator belt-driven by two 62.5-hp Olds engines operating on Pintsch gas. The apparatus was all housed in a brick station 70 ft. long, 53 ft. wide and 12 ft. high. The gas-producing equipment consisted of a Pintsch generator 10 ft. long and 4.5 ft. in diameter, with the usual auxiliary vaporizing and scrubbing apparatus. The plant was provided with a compressor for starting the engines at 150 lb. air pressure, the compressor being driven by a gasoline engine. The main engines were of the horizontal four-cycle center-crank type, each being equipped with a fly-wheel 9 ft. in diameter and weighing 4 tons. About 5.5 gal. of cooling water was required per hp-hour.

FIRST COST OF 75-KW GAS-PRODUCER STATION.

Real estate	$500
Building	1,150
Foundations of engines and generator	500
Engines, producer, clutch	7,960
Freight	800
Generator, 75 kw	1,300
Switchboard	380
Installing machinery	500
Wire	4,700
Poles	1,200
Transformers	1,050
Line work	500
Meters	3,000
Total	$23,540

Anthracite coal costing $6 per ton was burned in the producer and the heating value of the resulting gas was found to be 136.2 lb.-Fahrenheit thermal units per cubic foot. The coal showed on analysis 13,620 thermal units per pound, 85.2 per cent fixed carbon, 6.9 per cent ash and 6.2 per cent volatile matter. On a test the plant produced electrical energy upon a coal consumption of 1.71 lb. per kw-hour. A 4-kw belt-driven exciter was also in service. The first cost of the plant is shown in the table on page 569. The relatively high initial cost of a small gas-producer plant installed new throughout is apparent, the investment per kilowatt of rating being about $214. The low fuel consumption secured, however, is noteworthy, considering the small size of the installation.

OPERATING EXPENSES OF PRODUCER STATION SYSTEM PER MONTH.

Coal, 22 tons at $6	$132
Superintendence	150
Electrician	90
Two engineers	150
Bookkeeper	35
Office miscellaneous expenses	50
Oil and waste	15
Total	$622

All expenses of handling the property were included in the above, with the exception of fixed charges. The population served by the company at the time the figures were made was about 3000. The revenue per month was $880, of which the company received $550 from the sale of 5000 kw-hours for lighting service at a price of 11 cents per unit and $330 for the sale of 6000 kw-hours to motor users at a price of 5.5 cents. Three-phase distribution was made by the company, there being about 110 hp in motors connected to the system. After the expenses were deducted from the earnings there remained a balance of about $250 per month from which to pay interest, taxes, depreciation and dividends. The operating cost of the system per kw-hour sold was 5.65 cents. On the test of the plant, with conditions as favorable as possible under the circumstances, the cost of production covering operating expenses alone was 5.1 cents.

The plant was handicapped, among other things, by the use of too many small transformers on the distributing system. The service was also subject to interruptions on account of the inexperience of the early management. It was found that a saving of $593 per year could be effected by substituting fifteen 5-kw transformers for the existing installation of 35 units aggregating 75 kw. With the smaller units there was a total loss of 54 kw-hours per day compared with 25 kw-hours when using the larger equipments. Other improvements made were the utilization of a three-wire secondary system of distribution, the realignment of the poles, removal of wires from the limbs of trees and the installation of a new line shaft permitting the operation of the plant in units arranged according to the load, the capacity having been increased by the addition of a new engine, generator and gas producer and by the substitution of four 75-hp engines of the three-cylinder type for the original installation. At present the plant is distributing hydroelectric energy purchased from a large wholesaling company, finding this work more profitable than the generation of its own energy from the producer plant.

FORESTALLING AN ISOLATED PLANT BY CENTRAL-STATION SERVICE.

The problem of securing a contract for central-station service in a new building to be occupied by a number of manufacturing tenants is one of considerable importance in growing cities. In long-established buildings devoted to miscellaneous manufactures it is often possible to substitute central-station motor and lighting services for the system in operation on account of the depreciation of the plant and the inability of the equipment to meet the demands of an exacting clientèle for continuous and increasing service. New buildings, on the other hand, present many difficulties on account of the uncertainty as to the amount of power that may be needed by the tenants, the frequent recommendations of architects on behalf of an independent installation of electric generating equipment and the indefinite cost of operation prior to the establishment of the building on a thoroughly substantial commercial basis.

In a representative instance where a proposed isolated plant was forestalled by aggressive central-station service the building was located near the mercantile center of an important city and was designed to be occupied by its owners, miscellaneous manufacturers and retail stores. It was determined that about 300 hp would be required in boilers for heating and power purposes, about two-thirds of this capacity being needed for power alone. From the limited data available it was estimated that two generators of 50-kw and 150-kw rating would be needed to furnish energy for both lighting and motor service. Coal for both heating and power service cost $4.25 per ton, and water had to be purchased from the city mains. In order to treat the isolated plant fairly a load-factor of about 65 per cent was assumed for the installation, although this was somewhat higher than was common for installations of this character in the community served by the company. An operation of ten hours per day and twenty-five days per month was assumed.

The estimated cost of the plant is shown by the figures which follow:

150-kw engine and generator	$5,500
50-kw engine and generator	1,900
Foundations	1,000
200-hp boiler and settings	2,800
Switchboard	750
Feed-water pumps and heater	1,200
Wiring switchboard and connecting generators	500
Piping for engines, pumps, etc	800
Extra cost of stack for power purposes	300
Cost of meters for tenants' service	600
Total	$15,350

The estimated fixed and operating costs of the plant per year are given below:

FIXED CHARGES ON ISOLATED PLANT.

Interest, 5 per cent	$767.50
Depreciation and obsolescence, 5 per cent	767.50
Taxes and insurance, 1 per cent	153.50
Repairs and renewals, 4 per cent	614.00
Total	$2,302.50

OPERATING COST OF ISOLATED PLANT.

Labor (engineer, $20; fireman, $15)	$1,820.00
Coal, at $4.25 per ton	4,675.00
Water	450.00
Oil, waste, packing, boiler compound	150.00
Tools	25.00
Removal of ashes	240.00
Lamp renewals	200.00
Testing and adjusting 30 meters	250.00
Overtime electric energy purchased	750.00
Superintendence and clerical work	300.00
Total expense of isolated plant per year	$11,162.50
Total (Energy being sold to tenants by owners.)	$ 8,860.00

The estimated cost of operating the building by central-station service, leaving the heating to the owners, is shown in the table on the following page.

Central-station service was therefore installed, the estimated annual saving by its use being $621. In addition the

company made the important point that the services of its engineering department were worth at least $250 per year to the owners of the manufacturing building. The point was emphasized that in the case of a private plant this item would include such matters as indicating the engines, testing motors throughout the building, offering expert advice as to boiler economies and tendering assistance in relation to the various problems which frequently arise in buildings of this character. Similar problems, with the exception of the engine test, arise when energy is pur-

COST OF CENTRAL-STATION SERVICE, INCLUDING HEATING BY OWNERS.

Motor service at 2.4 cents per kw-hour	$7,020.00
Lighting service	1,004.15
Heating, with coal at $4.25 per ton	1,355.75
Labor, one fireman	624.00
Removal of ashes	60.00
Water	20.00
Overtime electric motor and lighting service	457.60
Total	$10,541.50

chased from an outside source. The energy consumption in most factories gradually increases, due to many causes, such as the installation of additional machinery, changed processes of manufacture, increased speed of machines, defective machinery or shafting and other causes. Where energy is sold by meter this increase is recorded, and frequently complaints due to ignorance of the cause arise on the part of the consumer. The central-station officers pointed out that on account of the company's wide experience such complaints could be better handled by their organization, with satisfactory adjustment of any difficulties arising between the landlord and the tenant in the subsale of electricity.

Another item which was not taken into consideration in figuring the cost of service by a private plant was the cost of energy lost in the distributing mains and meters throughout the building. With central-station service the amount lost in meters and transmission costs the landlord nothing, as only the energy passing through the meters is measured. With a private plant the losses have a direct effect on the coal consumption, the estimated cost being $170 per year.

Considerable emphasis was also laid upon the cost of superintendence and clerical work in the case of operating the private plant. This would cover such duties as the purchase of coal, oil and other engine-room supplies, reading tenants' meters, figuring bills, keeping account of the cost of power generators and many other items attendant upon the use of a power plant. The generation of power is one of the minor details in the operation of a factory building, and the time of the executive officials can be better spent along lines of increased sales, cheaper production or increased output than in dealing with technical power questions.

In applying central-station service the company installed all necessary meters and wiring on the consumers' premises, arranged to test the meters regularly and to send an itemized statement of the monthly readings to the owner of the building to enable him to base his charges for energy used by the tenants thereon. The owner was only required to pay for the total energy consumption of the property as indicated by the sum of all the meter readings, this being the same as for one customer with the equivalent total consumption of electrical energy. Under the central-station contract the building is furnished with all carbon incandescent lamps for the first installation and renewals free of charge, and tungsten lamps are sold to tenants for less than they can be purchased outside by private plants. In the awarding of the contract to the central station these important considerations naturally carried no small amount of weight.

REVOLUTIONIZING THE BUILDING TRADE IN DENVER.

By R. B. Mateer.

Heretofore when a new structure was planned in Denver, Col., and contracts were let the first move of the contractor was to get into touch with others of his trade or

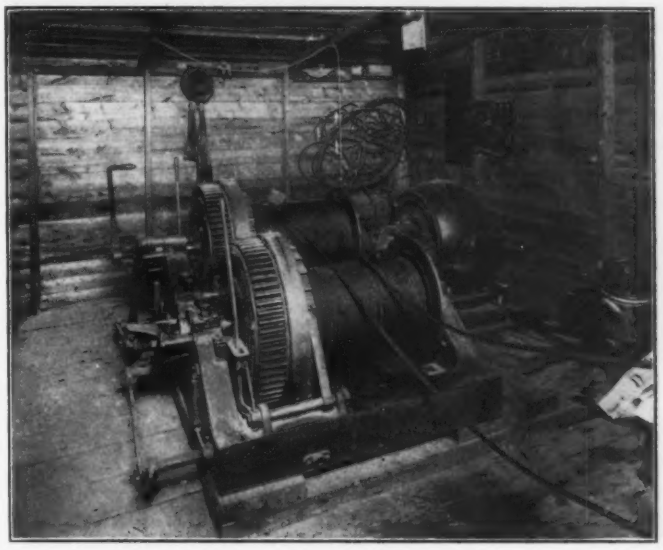


Fig. 1—Hoist at New Federal Building.

with machinery houses and either rent or purchase steam-operated machinery, such as concrete mixers, hoisting engines, etc. Several years ago some large warehouses of the slow-burning type were under construction, and after some effort the contractor was persuaded to purchase a small Chattanooga hoist and a small saw for the cutting of all large timbers. The machines were equipped with small motors of 3 hp and 5 hp respectively.

Realizing the advantages accruing through one installation, a strenuous campaign among Denver contractors by personal solicitation and literature resulted in others exhibiting some interest in the new and intelligent way of handling building material. To-day several large buildings are completed and others are in various stages of construction upon which all material was and is handled with motor-operated machinery. The new Chamber of Com-

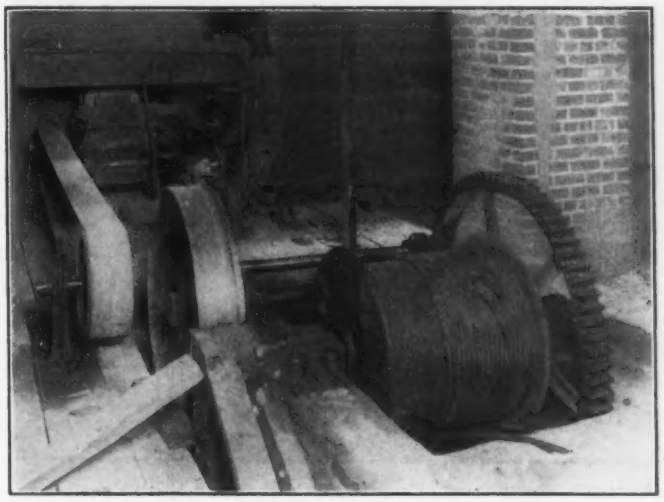


Fig. 2—Hoist for Concrete at Shubert Theater.

merce and the twelve-story Foster Building, for office purposes, were completed without the use of steam-operated machines. The concrete mixers, hoists and pumps were operated with direct-current motors supplied with energy

from the circuits of the Denver Gas & Electric Light Company.

At the new Federal Building, now under construction, a two-drum hoist, manufactured by the Leyner Engineering Company, of Denver, is direct-connected to a 20-hp, 500-

Fig. 3—Combination Hoist and Concrete Mixer.

volt Northern motor. As the building is constructed of Colorado white marble no steam, smoke or soot was desired around the new structure. The new Shubert Theater and office building is rapidly nearly completion and central-station service operates the motors used for the driving of the contractor's machinery. Fig. 2 shows the 15-hp, single-phase, 220-volt Wagner motor used to operate the concrete mixer. All concrete used in the building for floors, etc., is mixed and deposited in buckets, which are rapidly hoisted to the upper floors by means of the 10-hp hoist shown in Fig. 3. This hoist was built by the contractors and has proved very satisfactory. The forms upon which the concrete was poured were built on the premises. Instead of many carpenters a small 6-hp direct-current motor belted to a saw supplied those assembling forms with the necessary cut timber as rapidly as it could be used.

Electricity for contractors' machinery is to-day revolu-

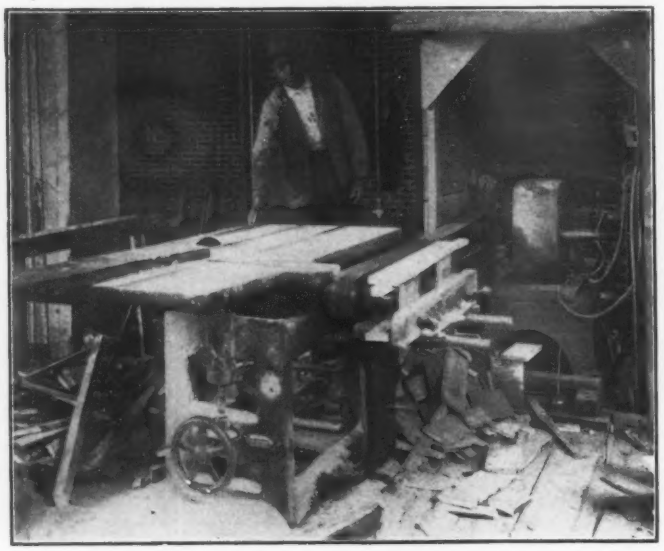


Fig. 4—Motor-Driven Saw for Cutting Lumber for Forms.

tionizing the building trade in Denver. Even the large stones used in the new Episcopal Cathedral were sawed and then finished prior to being put in place by means of electrically operated machinery which was erected on adjoining property.

RECENT TESTS OF THE COST OF ELECTRIC COOKING.

In connection with the installation of an electric range in the residence of Mr. Charles H. Williams, general manager of the Northern Colorado Power Company, Denver, the owner recently made a thorough study of the cost of electric cooking for a family of six persons for a period of ten days. Energy was supplied from the commercial circuits of the Denver Gas & Electric Light Company. The range used was an equipment manufactured by the Simplex Electric Manufacturing Company, of Cambridge, Mass., the size being the company's No. 6. The range was wound for 220-volt service and contained two 10-amp and three 20-amp switches controlling corresponding baking and stove circuits.

In the table which is printed below are given the character of meal, materials cooked, maximum demand in kilowatts, consumption of energy in kw-hours and cost per meal, the data commencing with the installation of the electric range. The cost of electrical energy is figured at 5 cents per kw-hour. No previous experience had been had with electric cooking. Records were taken by a pen-recording wattmeter which was carefully calibrated with an instrument of precision. Much care was taken to keep the range absolutely free from dirt during the progress of the cooking tests.

COST OF ELECTRIC COOKING, FAMILY OF SIX, AT 5 CENTS PER KW-HOUR.

Meal	Materials Cooked by Electric Range.	Maximum Demand in Kilowatts.	Kw-hours Required.	Cost, Cents.
Dinner	4.5 lb. roast lamb; baked white and sweet potatoes; baked rice pudding	2.4	2.7	13.5
Breakfast	Oatmeal; baked apples, 8; coffee	2.24	2.5	12.5
Lunch	Stewed prunes; tea; potatoes for yeast	0.6	0.87	4.3
Dinner	Clock mechanism disconnected	....	....	....
Breakfast	Oatmeal; coffee kettle of water	2.46	1.4	7.0
Lunch	Warming potatoes; finnan haddie warmed; tea	2.2	0.65	3.25
Dinner	3.5 lb. veal roast; baked sweet potatoes; 10 baked apples; baked Irish potatoes	2.8	4.35	21.75
Evening	Cooking oatmeal	1.0	0.47	2.35
Breakfast	Warming oatmeal; coffee	0.68	0.55	2.75
	Testing oven, raising temperature from cold to hot	1.4	0.7	3.5
Dinner	Stewing 4.5-lb. chicken; boiled potatoes; toast	2.08	2.0	10.0
Breakfast	Baked apples, 8; oatmeal; coffee; baking bread; stewing prunes	2.6	3.20	16.0
Lunch	Boiled potatoes; coffee; 3-lb. pot roast	....	3.15	15.75
	Warming coffee; laundress 2 p. m.	0.05	0.1	0.5
Dinner	Boiled sweet potatoes; baked potatoes; baked cornbread	2.4	2.75	13.75
Breakfast	Coffee; oatmeal	1.0	0.55	2.75
Dinner	Beef stew; carrots; potatoes; prune stew	2.0	2.5	12.5
Breakfast	Baked apples; oatmeal	2.48	2.55	12.7
Lunch	Warming meat and coffee	1.4	0.7	3.5
	Baking three loaves graham bread	1.28	1.35	6.75
Dinner	Chicken stew, 4.5 lb.; cranberries, 1 qt.; potatoes, boiled (6 large)	1.00	2.15	10.75
Breakfast	Baked apples; oatmeal; coffee	2.5	3.25	16.25
Lunch	Warming meat; coffee	1.6	0.35	1.75
Dinner	Meat pie; potatoes boiled	2.2	2.5	12.5
Breakfast	Oatmeal; coffee	0.6	0.6	3.0
Lunch	Warming meat; coffee; potatoes for yeast	0.90	0.6	3.0
Dinner	Baked finnan haddie; boiled potatoes; baked apple, cream sauce	2.60	3.5	17.5
Breakfast	Baked apple; oatmeal; coffee	1.0	0.5	2.5

Experience showed that some energy was lost by changing from one heat to another in order to regulate the temperature properly. It was found that after the oven was once heated baking could be done at small cost. Roughly, the cost of electric cooking varied from 3 cents to 10 cents per day per person upon the basis of the above rate per kw-hour.

BILLING AND RECORD SYSTEM OF THE NEW YORK EDISON COMPANY.

In a business supplying thousands of customers, aggregating millions of dollars a year and requiring a clerical force of 200 people to handle its bookkeeping, the New York Edison Company has applied a system which for absence of duplication is second to none. Only one item of all the intricacies of the transactions of this electric-lighting company is kept in duplicate—that of the meter readings, which in addition to being entered on the ledger are shown on the meter record. From the time the first reading is taken, through all the channels of the bookkeepers', bill clerks' and collectors' departments to the final acknowledgment of the payment of the bill, no other item is duplicated in the company's records. Even with this minimum there are great stacks of old records which literally fill up thousands of feet of floor space in the various buildings of the company.

With this elimination of duplication of records there is another factor which enters largely in the company's bookkeeping methods. Mechanical devices are used exclusively in keeping the statistical records, and mechanical addressing and mailing machines are used in sending the bills to the customers. It is the combination of the simplicity of record keeping with the adaptation of the mechanical features that makes it possible for the Edison company to handle its business with the dispatch that it does.

Following is a brief outline of the company's method of keeping its records and collecting its bills: As soon as the contract is signed a connection order is made out and after an investigation of service conditions is sent to the distribution department, whose men set the meter. The distribution department makes out a charge slip for the meter. This slip is made in duplicate and the copy is sent to the bureau of receipts, which makes its own record, to be kept in a binder. The duplicate is then sent to the bookkeeper, who enters it on his ledger and opens the account.

On the regular trip day the meter is read by the meter indexer, whose report goes to the bookkeeper. The bookkeeper computes the consumption of energy, enters the date of the reading in his ledger and extends the bill. The meter record is then sent to the bill clerk, who after making his extensions returns the bill to the bookkeeper. The bookkeeper compares the bill clerk's extensions with his own ledger extensions, and if all the figures are found correct the bill is sent to the tabulating desk, where the statistical records are taken from it. It is here that the first mechanical devices are used. Cards of different colors, known as the "bookkeeper's card" and the "statistical card," are punched with the necessary information. The bookkeepers' cards go through the sorting machine, which separates them in ledger and folio order. The total amount of energy sold and bills rendered for each ledger subdivided into totals for each 100 folios is obtained through this card. Fig. 2 shows an August bill for $39.31 entered in Ledger 51, folio 180. The energy consumption is 4100 kw-hours and is subject to a second rate, 241.6 kw being billed at 10 cents and the balance at 9 cents. This makes it possible to balance the ledgers in a very short time after all the entries have been made for the month.

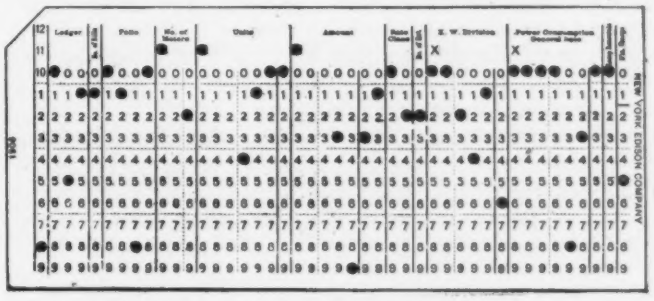


Fig. 2—New York Edison Statistical Card.

Through the statistical card are obtained the total number of meters on which bills have been rendered; the monthly consumption of energy; the monthly amount of bills rendered under the various rates; the percentage that each rate bears to the total amount of bills rendered; the average price of income per kw-hour under each rate; the average price of income per kw-hour for the total amount of bills rendered; the percentage of increase over the corresponding months of the previous year, and the percentage of increase over the number of elapsed months during the year. The system was of great value in obtaining data by which the company ascertained the effects of various rates on the annual income and assisted materially in adopting the rate which went into effect on July 1.

After bookkeepers' and statistical cards have been punched, the bill is mailed to the customer and under

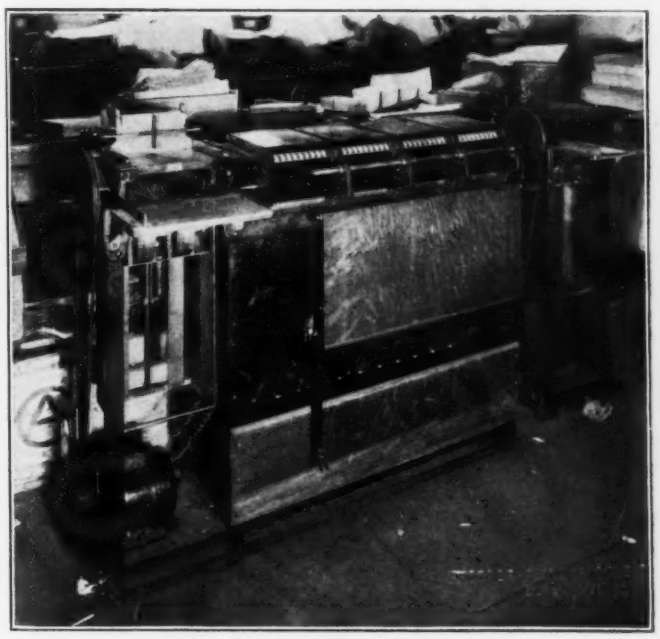


Fig. 1—Sorting Machine.

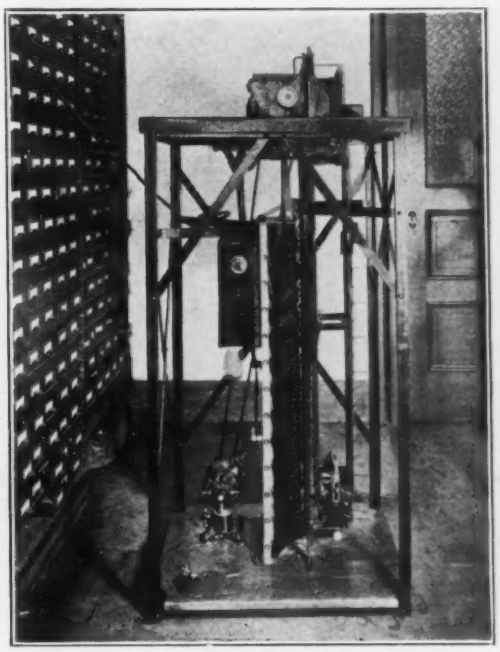


Fig. 3—Sorting Machine.

ordinary circumstances is received from two to four days after the meter has been read. The stub of the bill, which has been detached, is kept as a collection record, and ten days after the bill has been mailed, unless payment be made sooner, the first call is made by the collector. As soon as payment has been made, either to the collector, by mail or through one of the district offices, it is posted on the ledger within the working day. The working day is from noon to noon. No cash received is allowed to remain unposted over this period.

The bills are sent out by the mailing department, which uses an automatic sealing and stamping machine for closing the envelopes and affixing a stamp. Envelopes with transparent fronts are used, the bills being addressed on the addressograph before they are sent to the bill clerk for the extensions. The New York Edison Company renders bills on 112,000 meters in the city, and to keep the records there are fifty-four bookkeepers, sixteen bill clerks and hundreds of clerks to handle the miscellaneous work of the department. Thirty-seven meter readers are required to keep track of the consumption of energy as shown on these thousands of meters.

THE TESTING OF CUSTOMERS' METERS.

The committee on meters of the Ohio Electric Light Association, composed of Messrs. John Gilmartin, chairman; O. H. Hutchings and J. T. Kermode, presented its report on meter practice before the Cedar Point convention of July 25-28, covering the several topics of the importance of testing, proper intervals for tests, tabulation of results, definition of accuracy, accuracy data, jewel data, flat-rate controllers, etc.

While shop tests are necessary in order to put a meter in good working condition, said the report, experience has shown that meters do not always maintain their accuracy during transportation and erection, so that installation tests and inspections are advisable. Other factors which affect meter accuracy in service are vibration, moisture, changes in temperature, stray fields, short-circuits, varying voltages and varying wave-forms. To minimize these errors, especially where commutator-type meters are used, installation tests are necessary to adjust the meter to meet the conditions under which it is expected to operate. Meters have a natural tendency to run slow, but sometimes, through accident or changes in their immediate vicinity, a meter will run fast. Therefore, periodic tests assist in maintaining the accuracy of meters, bringing the company revenue that would otherwise escape, and, in addition, indicate the honesty of intention of the company toward its customers. For such tests rotating standards are, in the committee's opinion, best adapted, because of their simplicity of connection, direct reading and lower cost of calibration.

Investigations have shown that the losses in revenue due to the average inaccuracy of meters are much in excess of the expenditure required to carry on this work in a satisfactory manner. Considering individual consumers whose yearly bills are $50, $100, $500 and $1,000, and assuming their meters to be only 1 per cent slow, the losses would be, respectively, 50 cents, $1, $5 and $10 yearly. As the cost of testing meters would probably not exceed 50 cents to 75 cents per test, it is evident that meter testing is a source of revenue to the company besides a matter of simple justice to the customer.

The committee recommends the accompanying test intervals as the minimum for good practice.

The results of all tests should be tabulated and averaged so that the company may have reliable data at hand in case of controversy with customers or in dealing with supervising authorities. These data will also indicate how much revenue is being lost due to slow meters, how much money should be spent on the meters and the best way to spend it. It is therefore strongly urged that every company testing meters should total and average its results at least once a year. In tabulating such tests it is necessary to divide them into groups according to the purpose of the test. For example, from the viewpoint of relations with the consumers, it would be desirable to group separately all tests made on consumers' complaints of high bills so that it may be known what percentage of complaints are justified by fast meters. Again, from the viewpoint of meter operation it would be advisable to tabulate separately the tests made on each make of meter so that the results can be compared to show which make gives best results.

INTERVALS FOR METER TESTS.

	Yearly Income from Customers.	Proper Test Interval.
Commutator Meters:		
110-220-volt	$20 or less	Yearly
110-220-volt	$20 to $50	9 months
110-200-volt	$50 to $200	6 months
110-220-volt	$200 to $500	3 months
110-220-volt	Very large	Special
500-volt	Up to $200	4 months
500-volt	$200 to $500	2 months
500-volt	Over $500	Special
Induction Meters:		
Single-phase	$50 or less	2 years
Single-phase	$50 to $200	1 year
Single-phase	$200 to $500	6 months
Single-phase	Over $500	Special
Polyphase	$50	Yearly
Polyphase	$50 to $300	6 months
Polyphase	$300 and over	Special

For definitions and data on average accuracy the committee referred to and quoted the reports of the meter committee of the National Electric Light Association, the New York Public Service Commission tests, etc.

METER JEWELS.

If the jewel bearing becomes worn and rough the meter will run slow. To show the magnitude of this effect there are given below the results of tests made by an Ohio company on 700 meters having good sapphire jewels and 700 other meters in which the jewels had become worn. The meters were of the copper-disk commutator type and the test intervals and other conditions were approximately the same, so that the comparison shows the jewel effect only, the meters being identical otherwise:

	Number of Meters.	Average Accuracy 5 per Cent Load. Per Cent.	Average Accuracy Full Load. Per Cent.	Per Cent Not Recording at 5 per Cent Load.
Meters having good jewels	700	82.8	98.6	7
Meters having worn jewels	700	52.4	94.0	34

General dissatisfaction with the sapphire jewel has resulted in the development of the diamond jewel bearing, which is a very great improvement. The value of the diamond jewel is shown by a tabulation given on page 575 on the life of 500 sapphire and 500 diamond jewel bearings, expressed in revolutions of the meter shaft. The entries in the columns show the percentage of the jewels found defective at the number of shaft turns indicated by the column headings, which are given in thousands of revolutions.

For example, in the first column it is shown that at 200,000 shaft turns 10.2 per cent of the sapphire jewels had become defective, although none of the diamonds. In the fifth column, after 1,000,000 shaft turns, 69.7 per cent of the sapphires had become defective and only 4.2 per cent of the diamonds.

Many companies still have copper-disk commutator meters in service, but it is recommended that diamond jewels be installed in all copper-disk meters unless the revenue from such a meter is less than $15 a year. In aluminum-disk meters the sapphire jewels last longer, and the inaccuracy when they become worn is not so great.

	200	400	600	800	1000	2000	4000	6000	8000	10,000	15,000
Sapphire per cent.	10.2	31.6	45.4	59.8	69.7	90.0	98.0	98.7	100.0	..	..
Diamond, per cent.	none	.7	2.	3.6	4.2	7.4	12.3	20.0	29.3	43.0	51.2

The committee is therefore not prepared to give a definite recommendation here, except that diamond jewels should be put in the more important meters.

EXCESS DEMAND INDICATORS.

The excess demand indicator is a device designed for interrupting the service when the consumer exceeds a demand specified in his contract. An adjustment permits the tripping device to be set for any desired load. Correspondence with companies having several indicators in use shows that the repair and removal cost has been very small, and that in general they have given satisfactory results.

A feature reported by one company is that, if the indicator is set for 100 watts and a 500-watt iron is connected in circuit, the vibration of the contact is so rapid that sufficient energy to heat the iron is permitted to flow. Another company reports that, when installed on a porch or in other places where the temperature is low, the oil in the case congeals, preventing the satisfactory operation of the switch.

The voltage drop in some indicators is also too high, which has caused complaints of poor light from consumers. One company reports from 2 volts to 5 volts drop. Tests made by the committee on a 10-amp, 110-volt, 60-cycle indicator showed that with 110 volts on the line side the pressure on the consumer's side of the indicator was 104 volts, or a drop of 6 volts. This drop is about one-half ohmic. A meter under the same conditions would not give over one-half volt drop. Another test by the committee showed that if a 10-amp, 110-volt indicator was adjusted to trip at 220 watts, and then 1100 watts load was thrown on, the vibrator would work rapidly enough to allow an average of 450 watts at 65 volts to be delivered to the load. A 10-amp indicator was short-circuited twice, blowing 30-amp fuses in approximately one second, and sustained no apparent injury.

The report of the meter committee was supplemented by a varied exhibit of meters and testing devices and methods in the convention hall.

Discussion.

In discussing the committee's report Mr. W. L. Cook, of Columbus, Ohio, raised objection to the testing of meters on the customer's premises, declaring that in such cases the standard test meter is subject to the same errors, due to handling, variations in voltage, frequency, stray field, etc., so that the customer's instruments may be wrongly calibrated. The difficult conditions under which customers' meters must usually be tested on the premises also cause slighting of the work and prevent the degree of accuracy that would be obtained in a well-equipped laboratory, where all meters are tested under identical conditions. Most electric companies will not permit their representatives to give information to the public, and when a meter tester is asked by the customer regarding his meter's accuracy the indefinite answer given, said Mr. Cook, is sure to create dissatisfaction and suspicion that the meter is registering wrongly. The publication of meter-accuracy data showing the small per cent of meters tested and found in error would, according to Mr. Cook, do much more harm than good, since each dissatisfied customer would at once form the notion that his own meter was one of the few erring instruments. For this reason the use of meter-accuracy tabulations in controversies with customers is without effect or conviction upon the consumer, who at once assumes that the company is trying to evade his complaint. Mr. Cook suggested that laboratory tests of meters would also be found much less expensive than tests on the customer's premises.

Mr. R. S. Graves, of Schenectady, N. Y., said that in his estimation the customer's test approaches most nearly to giving correct settings, in spite of varying conditions, moisture, vibration, etc. Mr. G. R. Smith, of the New York Edison Company, reported that special four-pole meters have been used on switchboards in New York City where the presence of stray fields is suspected. Meter tests there are made on the customer's installation, and the customer is invited to have his own expert or engineer present at the time specified in a notice sent out. In many cases, he said, the expense of removing a meter for laboratory test would be too great.

A MODERN CENTRAL-STATION STOREHOUSE AND PLANT OFFICE.

Except in metropolitan centers few central-station properties are equipped with adequate or specially designed storehouses or stockrooms for supplies in constant use, resort usually being had to some unoccupied building, room or corner of the plant often ill adapted to this important purpose. With an 8600-kw electrical system serving 18,000 customers in a city of 75,000 population at a shipping distance one week away from the nearest electrical distributing point, Kansas City, Mo., the necessity of keeping on hand a sufficient stock of supplies grows imperative. To meet this need as well as to furnish offices for plant superintendents and engineers, drafting rooms and educational facilities for its employees the Oklahoma Gas & Electric Company has recently completed on its plant property at Oklahoma City the handsome and well-arranged storehouse building illustrated and described herewith. The new building is entirely distinct from the downtown business offices of the company, and is devoted entirely to the practical ends of plant operation and maintenance.

Fig. 1—Storeroom for Construction Materials and Supplies.

The building is a two-story structure of red brick trimmed with white stone, and measures over all 210 ft. x 75 ft. Behind it is the company's 80-ft. x 31-ft. garage building, of similar construction, while the entire property is inclosed by an ornamental brick-and-iron fence.

Between the two wings of the main building, as shown

in the accompanying plan sketch (Fig. 2), runs a 15-ft. driveway through which the supplies and line wagons can be driven, stopping at the doors of the storerooms, toolroom, machine shop, etc., to take on or unload supplies. A double row of lamps under the building cornice lights this driveway so that wagons can easily be loaded and checked after dark.

The general storeroom (Fig. 1) measures 86.5 ft. x 30 ft., and is arranged with three doors opening onto the driveway court. In this room are stored all line material, transformers, arresters, supplies, wires, etc., withdrawals being recorded by a complete checking system in charge of the storekeeper, Mr. T. A. Gresham, whose office is at the front adjoining the storeroom. Elevators and stairway connect with the second floor.

The west wing of the building on its lower floor contains the superintendent's offices, the troublemen's office, the line toolroom adjoining the line superintendent's office, the gas-meter proving rooms, machine shop and blacksmith shop. The machine shop, which is equipped for making most of the plant repairs, contains one 25-in. and one 15-in. lathe, a 26-in. and a 15-in. drill press, shaper, planer, etc., all motor driven. Together the machine and blacksmith shops occupy a space 60 ft. x 30 ft.

Under the stairway leading to the second floor in the east wing a photographic darkroom has been fitted up. Photographs are frequently taken of progress on new work, line construction, etc., and the darkroom is a convenience to the superintendents, who have their own cameras.

Besides the elevator there are four stairways for reaching the second story. On this floor are the arc-lamp and meter-test rooms, engineering offices, library and auditorium.

The arc-lamp test room, 31 ft. x 23 ft., shown in Fig. 3, contains a five-lamp constant-current test transformer, while 2300-volt alternating-current and 110-volt direct-cur-

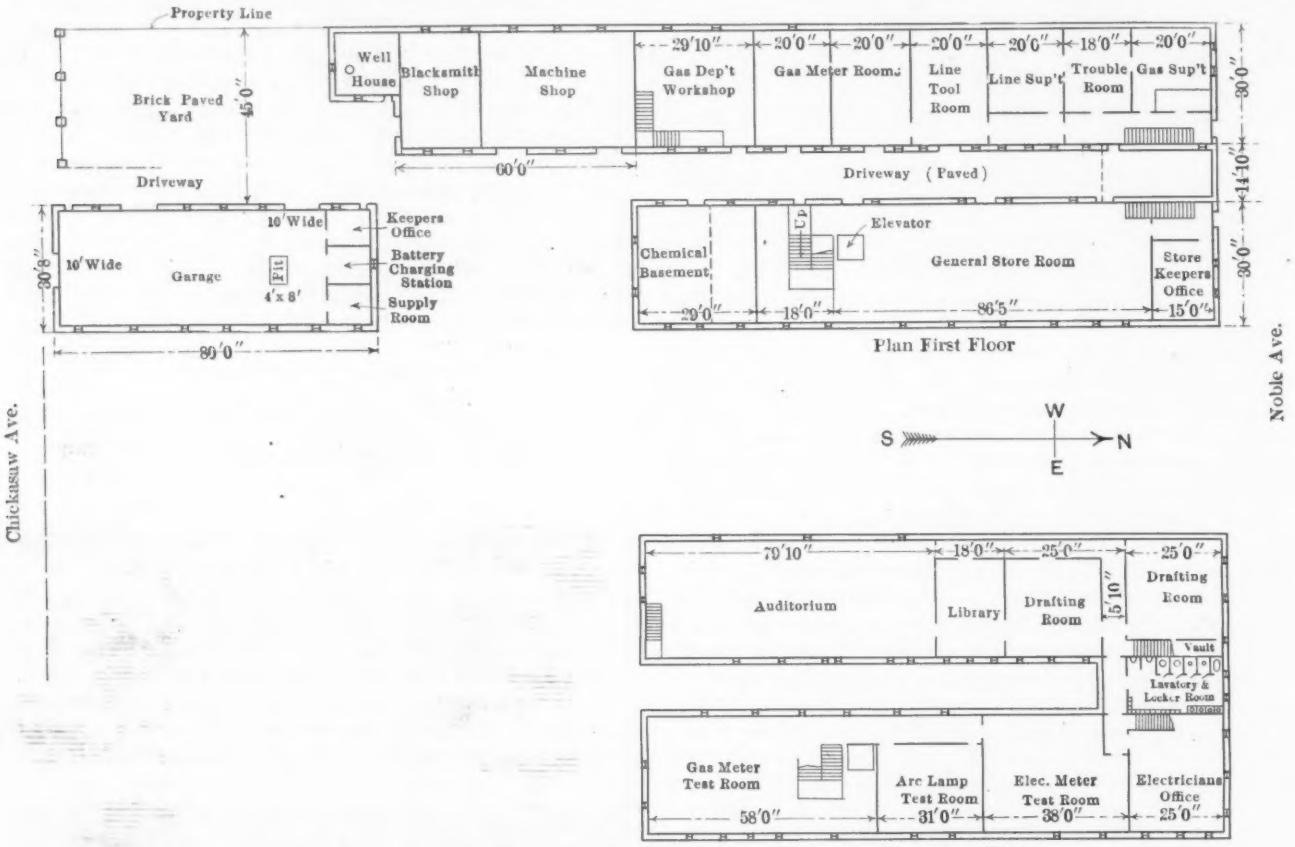


Fig. 2—Plan of Storeroom Buildings.

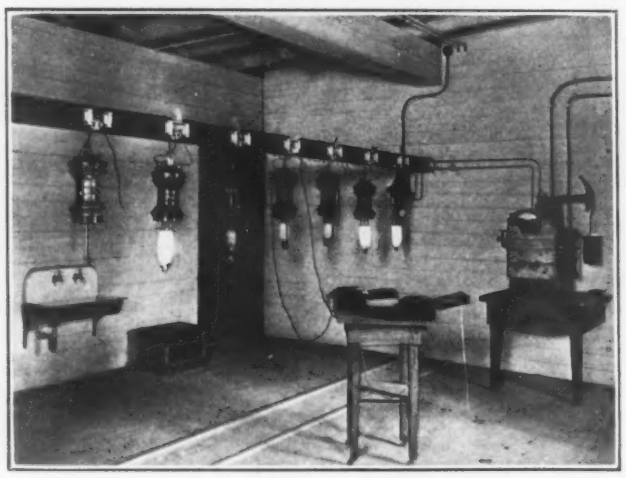


Fig. 3—Arc-Lamp Test Room.

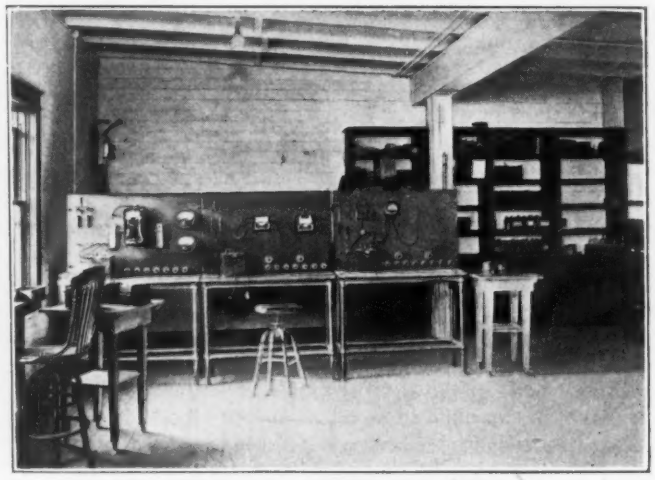


Fig. 4—Meter-Testing Department.

rent lines are brought into the room, so that any type of lamp can be tested as required. The lamp rack is arranged for seven lamps, and is equipped with connection plugs for bridging voltmeter leads as well as inserting ammeters into any lamp circuit. The instruments themselves are placed on a roller table, which can be moved about the room. The floor under the lamp racks is protected by a broad zinc trough.

The local lamp department tests and inspects 500 arc lamps, all but twenty-five of which are in use on the city series lighting circuits. Two lamps are replaced and brought into the office for test daily, and this routine, together with the lamps that are removed for cause, results in a complete test of the 500 lamps installed at intervals of from 250 days to 300 days. Record cards are kept for each lamp, showing the location at which it has been installed, volts, amperes, watts and other test data, repairs, etc., so that the history and performance of any unit are apparent at a glance.

Next to the lamproom is the watt-hour meter-test room (Fig. 4). This room is partially inclosed by a wire grilling, no one but members of the meter-test department being admitted. From the shelves the meters are placed on wheel tables and rolled over to the test tables. The table at the left is arranged for testing large meters, a current transformer furnishing low-voltage currents up to 600 amp, while 110-volt, 220-volt and 550-volt taps are available for the potential windings. Direct-current meters are tested on alternating current, using non-inductive resistance. Each of the other tables arranged for testing meters up to 25-amp rating is fitted with extra racks for warming one meter during the test of the one preceding it. The meters are tested in comparison with rotating standards, which in turn are compared weekly with a standard laboratory voltmeter and ammeter.

The meter-testing department takes care of 7500 meters, individual records of which are kept by means of a card-catalog system. The meters are tested on the consumer's premises every six months, so that an opportunity is afforded for checking them soon after installation.

The office of the chief electrician of the company, Mr. F. J. Meyer, adjoins the meter and arc-lamp test rooms, the test work being part of the general department under his charge.

The bridge spanning the driveway is occupied by a well-equipped toilet, lavatory and locker-room. The west front office is a drafting-room used by the engineering department, and behind it is another office. These drafting-rooms are equipped with fireproof vaults for plant records.

For the educational welfare of the company's employees an auditorium and a library have been provided. The library is furnished with current electrical and engineering magazines, and a number of easy chairs invite their perusal and study. The company also has a set of standard electrical text and reference books which it loans to employees. These books are in charge of the storekeeper and may be drawn out by any employee interested. In addition to the use of the library and books, lectures are given to the employees at intervals in the large 80-ft. x 30-ft. auditorium in the west wing of the building.

The talks, which are given by men of standing and experience, are on practical electrical subjects and are considered of value in stimulating the interest of the men and in causing them to understand their own and correlated work. The auditorium is equipped with a projecting lantern to display stereopticon slides. On week days the auditorium is also put to use as a lunching place for employees, the company having under consideration the plan of serving coffee or a light lunch at cost.

The electric and gasoline automobiles and trucks of the company are stabled in a separate 80-ft. x 31-ft. brick garage building. The company has six gasoline runabouts and five electric vehicles, four of which are trucks. For charging the batteries of the electric cars a 17-kw motor-generator set has been installed.

The plant storehouse and employees' building of the additions and changes in the adjoining power plant of the company were designed and carried out by the engineering department of H. M. Byllesby & Company, Chicago, who operate and manage the Oklahoma Gas & Electric Company. Mr. F. H. Tidman is local general manager at Oklahoma City.

Wiring and Illumination

THE LIGHTING OF A MODERN BARBER SHOP.

Of the various shopkeepers in a community none is better fitted to advertise the merits of electricity for lighting than the barber. In order to make such an establishment go cleanliness is one of the essentials, and since much of the barber's outfit is susceptible to electrical operation it is but natural that electricity should be employed for illumination.

An excellent example of a modern barber shop is connected to the service of the United Electric Light &

Interior of New York Barber Shop.

Power Company, of New York City. A view of the interior of this shop, which is located at 3795 Broadway, is given herewith. The general illumination of the shop is obtained from six 100-watt tungsten lamps suspended in large diffusing globes. In addition, there are eight "Alba" glassware columns, surmounted by globes, arranged in front of the mirrors which line one side of the shop. Each of these contains seven 16-cp incandescent lamps. Although many patrons would never suspect it, the barber requires good illumination on the face of the customer in order to shave him properly, and this, needless to say, is obtained in the shop herewith described. The system of lighting installed is at once economical and on the whole very satisfactory. The color of the light, combined with the whiteness of the chairs and marble fittings, imparts to the room a soft and pleasing glow unmarred by glare or over-illumination. In addition to the electric illumination of the shop the owner has provided himself with nine electric vibrators and other electrical appliances useful in his trade. The shop is located in a thickly populated section of the city and caters to the average class of trade, so that it is in no sense an establishment maintained especially for the wealthy.

MAGNETITE-ARC VERSUS TUNGSTEN-POST LIGHTING.

The Rochester Railway & Light Company, Rochester, N. Y., has recently erected for demonstration purposes on two adjoining blocks along Main Street an installation of

Fig. 1—Tungsten Ornamental Standards in Rochester.

6.6-amp magnetite-arc lamps. On the block immediately below this installation there is an installation of ornamental posts, each fitted with five tungsten lamps, the idea of

Fig. 2—Magnetite-Arc Posts in Rochester.

the company being to show to the various business men's associations the actual illumination obtained from both types of ornamental street lighting. The magnetite-arc lamps have been erected in pairs on an ornamental extension to the trolley poles on the street, so that they utilize existing poles and do not add to the obstruction already on the sidewalk. The lamps are suspended well up in the air, as shown in the accompanying illustration, so as to be out of the direct line of vision. The tungsten posts, on the other hand, are spaced very close together, and, of course, add to the obstructions on the sidewalks. At night the magnetite block is brilliantly illuminated, whereas the block with the tungsten lamps presents a very subdued lighting effect, with an entire absence of high lights. During the daytime the slender and higher poles on which the magnetite-arc lamps are suspended are scarcely noticeable, whereas the tungsten posts with their white diffusing globes present the appearance of a picket fence when viewed at a certain angle. Despite the better illumination given by the magnetite installation the general public opinion, so far, has been somewhat in favor of the tungsten installation, but as yet no definite action has been taken looking toward the general installation of either.

CONCRETE-POLE LINES ON THE MEADOWS DIVISION OF THE PENNSYLVANIA RAILROAD.

In a paper entitled "The New York Tunnel Extension of the Pennsylvania Railroad Company, Station Construction, Road, Track, Yard Equipment, Electric Traction and Locomotives," to be presented before the American Society of Civil Engineers Oct. 18, Mr. George Gibbs gives some details of the concrete-pole lines on the Meadows section of the railroad. This section is a 5-mile continuous stretch in semi-tidal swamp land except for a short section of rock outcropping at Snake Hill, N. J. The Hackensack River is crossed midway of the section. The ground surface is covered with a heavy growth of reeds, and the top stratum is of peaty bog from 8 ft. to 15 ft. deep, underlaid with varying strata of clay, fine sand and mixed sand clay for very considerable depths. Across this section and adjoining the track embankment a concrete-pole line was erected for telegraph and telephone purposes.

The ultimate telegraph and telephone service will require sixty open wires and two forty-pair cables, and it was desired to make this line entirely secure against probable interruption by severe storms or fires in the swamp reeds. The character of the foundation was bad, and after due consideration it was decided to substitute for an H wooden-pole line, which would be inadequate for the conditions, one of concrete poles, which, while somewhat experimental and perhaps somewhat more costly, would provide a safe and durable construction. In this section 202 poles

Fig. 1—Concrete-Pole Line on Pennsylvania Railroad System.

were required. They are spaced from 70 ft. to 135 ft. apart, with an average standard span of 120 ft., the variations in span being due to numerous railway and highway crossings. The heights of the poles above ground vary

from 25 ft. to 50 ft., and they are from 35 ft. to 65 ft. in total length. The design made by Mr. R. D. Coombs called for transverse loading conditions in case of maximum storms equivalent to 6000 lb. at 6.5 ft. below the top of the pole for the 120-ft. span length. The poles are square in cross-section, with chamfered corners, and with a taper of ½ in. in 5 ft. The 1:2:4 concrete mixture of which they are made was assumed to have an ultimate unit strength in compression of 2200 lb. The reinforcement is composed of mechanical bond bars tied together into a square skeleton frame. In the completed pole this reinforcement is covered by a 1-in. minimum thickness of concrete. The skeleton reinforcement was placed in horizontal frames and the concrete mixture was poured in and carefully tamped. The average number of poles made per

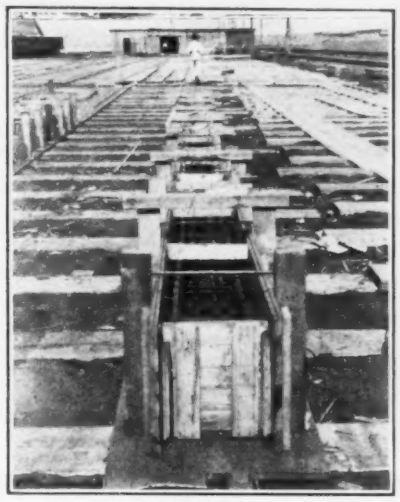


Fig. 2—Method of Making Concrete Pole.

day was six, and these were left in place sixteen days to season.

After a number of experiments it was found best to set the poles in pits excavated in the marshy stratum. These pits were generally about 9 ft. square and 5 ft. deep, and a timber grillage was placed around the base of each pole and about 5 ft. below the top of the ground. This grillage consisted of six track cross-ties bolted together and to the pole and partly planked over by 3-in. rough lumber. The

Fig. 3—Grillage in Marshy Stratum.

pole, which projected below the grillage, was pointed at the butt and was jetted down by compressed air into the sandy layer so that the grillage would rest at the bottom of the pit. The pits were then back-filled with rock and clay. The poles on curves are cross-guyed and the terminal and railway-crossing poles are head-guyed with steel cables. Because of the unusually heavy line and the extreme length required for the foundations, the gross weight per pole, exclusive of grillage and cross-arms, is more than would be required for ordinary telegraph poles and varies from 5300 lb. for a 35-ft. pole to 17,300 lb. for a pole 65 ft. in length.

INCREASING USE OF FLAMING-ARC LAMPS.

In the five years that the flaming-arc lamp has been in use in this country it has been adopted for use in three general fields—spectacular or show lighting, commercial and industrial lighting and lastly for municipal lighting.

Fig. 1—Flaming Arcs in Front of New York Restaurant.

For three years after its introduction in this country the flaming arc, while admittedly far superior to the standard arc of the inclosed type as far as efficiency was concerned, was handicapped by the fact that it would burn only from ten hours to seventeen hours as compared with the 100-hour to 120-hour life of the inclosed-arc lamp.

Its dazzling brilliancy, however, more than compensated for this in the theatrical and hotel field, and even in some commercial applications, but civic authorities would not accept the lamp until it had been so improved that at least 100 hours per trim could be obtained from its electrodes. Now that this stage of development has been reached the

Fig. 2—Flaming Arcs in Front of Clothing Store.

city of Chicago has tentatively decided on flaming-arc lamps for all its streets and thoroughfares. The first consignment of lamps of this huge installation—15,000 lamps will eventually be installed in the Windy City—is now being

prepared in this country and will be shipped within a few weeks.

The flaming arc is distinctly a European product and has been used on the other side for about ten years. It was more suited to European conditions, burning on the same voltage as the arc lamps it displaced so largely. In this country the arc lamps burn on a different voltage from those in European cities, thus requiring some changes before the flaming arc could be installed. The flaming arcs that are made in this country are suited to American requirements, and they combine the high efficiency of light with the long life of the electrode.

It is conservatively estimated that on Broadway, New York, below Columbus Circle, there are more than 500 flaming arcs. They illuminate theater fronts, restaurants, roof gardens, "lobster palaces" and dry-goods stores, while the lower East Side of the city, with its Grand Street business interests and Bowery amusement centers, has probably 1000 flaming arcs. Hammerstein's Theater, at Forty-second Street and Seventh Avenue, uses sixteen arcs, most of them on the street sides of the building, although several are placed on the roof; the American Music Hall, at Eighth Avenue, has an installation of flaming arcs, while just across the street a men's furnishing establishment has the two street fronts of the building illuminated with flaming-arc lamps. The conservative Shanley restaurant, the Kaiserhof and Churchill's are among the eating places that stand out in the lurid glare of the flaming arc. The Manhattan Opera House and all the Shubert theaters employ the flaming arcs to attract the amusement seeker.

There is hardly a business place on the Bowery that does not boast at least one flaming arc over its entrance. Interspersed with the Bowery merchants are many moving-picture theaters, each of which uses the flaming arc. Just above the entrance to the Brooklyn Bridge Park Row is one huge glare when all these lights are burning. From a business point of view there is no night, for there are

Fig. 3—Flaming Arcs at Broadway and Forty-ninth Street, New York.

toilers whose work keeps them out until the small hours, and to catch their trade the merchants always have their stores open. Grand Street is so brilliantly illuminated by the flaming arcs installed by the show proprietors and shopkeepers that the street lamps supplied by the city pale into comparative insignificance.

Coney Island, of course, is world-famous for the brilliancy of its electric lights. Part of this great brilliance is furnished by the flaming arcs that are to be found everywhere. In Luna Park there are about 150, Steeplechase Park has about sixty, the Eldorado Carrousel, which was opened for the first time this season, has an installation of

Fig. 4—Flaming Arcs at Thirty-ninth Street and Broadway, New York.

about the same size as Steeplechase, and the Electric Scenic Railway has ten arcs on its street façade. In all there are about 500 arcs of this type on the "Island."

The industrial plants that use flaming arcs for interior illumination are all outside the city. The American Bridge Company, of Pittsburgh, uses about 100, the United States Steel Corporation at Youngstown, Ohio, has several hundred, the Union Metallic Cartridge Company employs about thirty, the Newport News Shipbuilding Company of Virginia has about twenty flaming arcs in use when one of Uncle Sam's sea fighters is under construction, the government has about twenty-four at the Rock Island Arsenal in Illinois, while the Central Railroad of New Jersey has thirty arcs in its train shed at Communipaw, N. J. The United States Motor Company has more than 1000 arcs in its various plants.

In building construction in New York City the Thompson-Starrett Company uses about 140 flaming arcs, transferring them to their various operations as need arises. One hundred of these lamps were on hand during the construction of the big Gimbel Building, at Sixth Avenue and Thirty-second Street, for in order to complete the work on time it was necessary for the men to toil night and day. When the grandstand of the Polo Grounds burned down at the beginning of the present baseball season it was thought by many that the "Giants" would be without a home ground for the ball game. They were permitted the use of the American League Park for their early games and arrangements were made for the rebuilding of the stands. The contractors, Snare & Triest, agreed to have the stands ready for the "fans" by the first of July and to make good on the contract it was necessary to keep their men at work night and day. Six flaming arcs were installed and the job was finished on time.

The Bradley Contracting Company, which is building several sections of the Brooklyn subway, uses the flaming arcs on the work. The company transfers its arcs from

various points on its jobs and will probably increase its installation as work progresses on the Lexington Avenue subway in Manhattan. As most of the aqueduct construction is in the nature of tunnel work, incandescent lamps will be generally employed, although the arcs will be used on the surface to light up the working yards and the shaft headings.

The adoption of the flaming-arc lamp for general street illumination appears to be foreshadowed by the recent action of the city of Chicago providing for the purchase of 4000 lamps at once as the first instalment of 15,000 flaming arcs for street lighting.

DISPLAY LIGHTING IN DENVER.

No one can visit the more progressive centers of population in America at the present time without becoming aware of a general movement in the direction of intensified illumination. Several reasons combine to increase the use of electricity in this important service. The power of well-planned sign, outline, window and street lighting to attract both transient and permanent inhabitants into the business district during the evening hours has been settled beyond question. The old days of allowing the commercial center to plunge into the depths of Stygian darkness at nightfall and leaving it deserted by all except the police and wayfarers of questionable aim until the beginning of the next day's business are passing away, and in their place is coming a time when the early evening will be as valuable for the transaction of business as any other period of the day—in fact, the era of increased sales through the banishment of night has already arrived, and it only remains for the larger application of electric illumination to revolutionize the business conditions of modern cities, creating for the merchant the same long-hour patronage that renders the cultivation of display lighting so desirable from the central-station standpoint.

Outside the great cities of this country, and with few exceptions surpassing them in the intensity of display lighting effected on main business thoroughfares, the city of Denver, Col., furnishes the most conspicuous example at present available of a community which is almost to a man enthusiastic in the adoption and extension of special illumination for the general benefit of the business area.

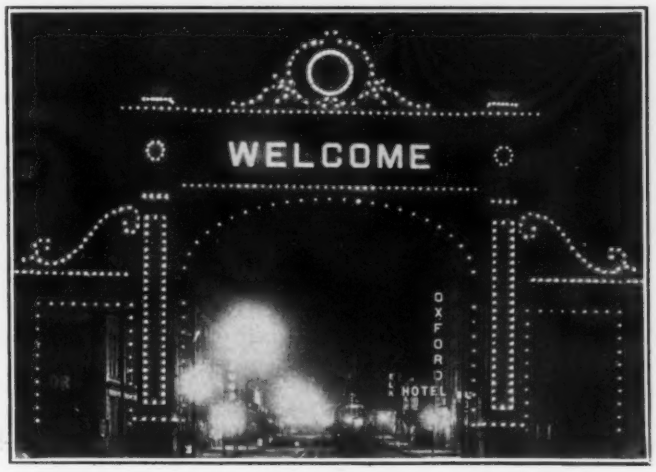


Fig. 1—Welcome Arch at Entrance of City.

Seven years ago downtown Denver differed little from any other city of comparable size in the matter of illumination. To-day it is estimated that the amount of display lighting supplied in the mercantile district of Denver is larger in relation to the area covered than in any other municipality in this country. The intensity of illumination upon a given street is probably less than that on Broadway, New York; but, taking into account the remarkable installations of electric sign, window and outline lighting existing on the cross streets, it is doubtful if any other place is making use of so much light per square mile of business district. The effect of this policy has been to change the face of the

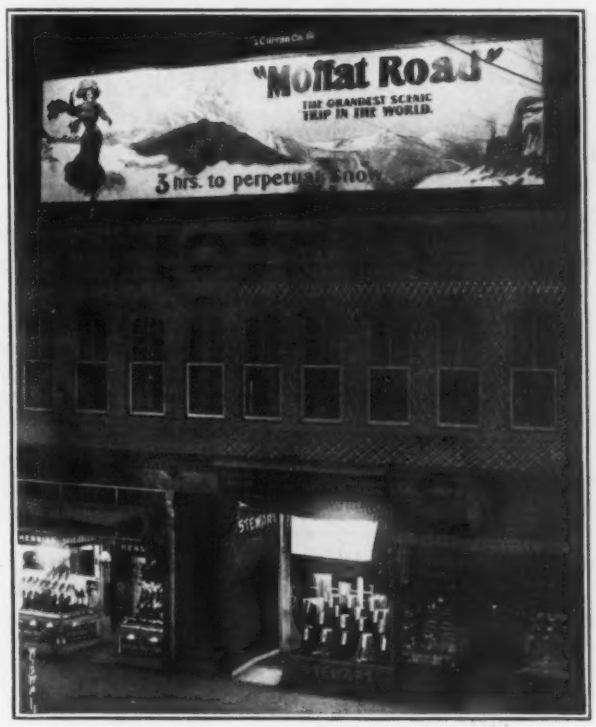


Fig. 2—Typical Billboard Lighting in Denver.

entire city at night, to stimulate travel to and from the business center many hours after the retail establishments have closed for the day, and to develop an unknown but certain volume of extra patronage for every business agency thus utilizing the local central-station service. So conspicuous has the display lighting of Denver become that the municipal authorities, Chamber of Commerce and other responsible organizations have turned the use of electricity to account in advertising Denver as the "City of Lights," and this designation has gone far to supplant the earlier titles to fame which have spread abroad its reputation.

The electric service of Denver is supplied by the Denver Gas & Electric Light Company, whose department of illuminating engineering is in the main responsible for the extent to which display lighting has become popularized. At the entrance of the city the first object which strikes the eye of the visitor making an evening arrival is an elaborate "Welcome" arch located at the foot of Seventeenth Street and directly in front of the Union Station. Emblazoned upon the outside of the arch in letters of light is the welcoming word of the city, and on the reverse side the word "Mizpah" bids the parting guest God-speed. The arch is lighted by 1294 4-cp incandescent lamps; it is a permanent design, being operated every night in the year, and is built of steel and bronze, with the seal of the city outlined in incandescent lamps at its crown. The cost of the arch was $22,000, and the city pays the lighting company $900 per year for supplying it with energy. There is no question that the arch is a good investment for the city, Denver being one of the great tourist centers of the Rocky Mountain district, and it is possible upon the daily arrival of the evening trains from outside points to hear expressions of enthusiastic appreciation from incoming travelers. About 2500 arc lamps of from 5.5-amp to 7.5-amp rating and approximately 1000 60-watt incandescent lamps are in service in Denver street lighting. The population of the

city is about 215,000. One of the latest additions to its street-lighting equipment was recently installed on Speer Boulevard, an improved park thoroughfare built under the present municipal administration for a distance of about 3 miles paralleling the banks of Cherry Creek. The boulevard is lighted by 75-watt series-tungsten lamps carried on 10-ft. iron poles surmounted by opal globes, the

Fig. 3—Night View of Fifteenth Street, Denver.

lamps being about 100 ft. apart. The energy supplied to the lamps is distributed through cables laid in ordinary earth trenches, the cables being coated with a moisture-proof preservative. The city pays the company $20 per lamp per year for this service. By the construction of this boulevard and its equipment with tungsten lamps a section of the city formerly given over to dumps and slums has been transformed into an attractive driveway, and the city authorities have decided to provide a similar illumination on all the viaducts crossing railway yards in the municipality.

The city authorities have lately established and maintained out of the general revenue funds a system of decorative arc lighting on Fifteenth, Sixteenth and Seventeenth Streets, the principal avenues of traffic between the Union Station and the up-town centers. This system comprised the removal of all overhead wires on these streets except the trolleys of the local railway company. By agreement with the latter it was arranged to use their trolley poles as a foundation for the standards carrying the lamps. The latter are alternating-current units of about 550 watts rating and are surrounded by translucent globes. The poles are of artistic appearance, and are set eight per block, four on each side of the street, there being seventeen blocks on each of the principal streets covered between Broadway and the Union Station. The cost of the poles was about $160 apiece, the expense being divided between the Denver City Tramway Company and the city. The price charged for arc lamps on all-night and every-night service is $60 per lamp per year, and the price charged for 60-watt incandescents is $28 per year. The cost of street lighting in Denver in 1910 was about $157,000, exclusive of parks. The appropriation for street lights in 1910 was $175,000. New lamps are added monthly in all parts of the city which are not well provided with such facilities, and it is probable that within a few years there will be an electric lamp on practically every corner of the 1250 miles of streets and roadways within the city limits.

During the meetings of conventions in Denver the principal streets in the business district are also illuminated by arches and festoons of colored incandescent lamps, and the Auditorium, a structure owned by the city and seating about 12,000 persons, is outlined by about 7000 tungsten lamps of 4-cp rating. The State Capitol dome, 255 ft. in height, is nightly outlined by streamers of colored incandescents and surmounted by a beacon consisting of about twenty-five 50-cp carbon lamps inclosed in a single globe. The Denver County Court House is also outlined nightly in incandescent lamps. The most conspicuous feature of outdoor lighting in Denver, however, is the new office building of the Denver Gas & Electric Light Company, which is located in the heart of the business district at the intersection of Fifteenth and Champa Streets. Thirteen thousand incandescent lamps are installed on the two street sides and cornices of this building, there being in nightly service 8000 4-cp tungsten lamps and 5000 units ranging from 25 watts to 250 watts. The building is a beautiful structure of white marble rising to a height of ten stories above the street, and its nightly illumination can be seen from practically all points in the city. So brilliant is the illumination that ordinary newspaper print can be read at night by the light of the building, the reader standing on the belfry of the Daniels & Fisher campanile, about 325 ft. above the street and nearly 1000 ft. distant.

A striking development has been attained in Denver in the fields of electric-sign and billboard lighting. There are now about 800 electric signs in service in the city, 80 per cent of which are operated on flat rates, burning for the most part from dusk to midnight each day. About 100 billboards are electrically illuminated, and both these branches of business are rapidly growing. Last year the revenue from display lighting increased nearly 24 per cent. Window lighting is to a large extent handled on flat-rate contracts upon the same terms that apply to sign and billboard illumination. The advent of the tungsten lamp has been utilized by the company to push the installation of larger lighting units, and on account of the advertising value of brilliantly lighted business establishments it has been possible to carry the magnitude of the installations far beyond that found in many cities. Three years ago there were barely 300 electric signs in service in Denver, and the phenomenal increase of this class of business can only be accounted for by the skill with which the company has educated the public to appreciate the drawing power of electric lights skilfully installed in mercantile houses. An interesting point in connection with the growth of display lighting in Denver is the increase in the average size of unit installed from 107 watts in 1910 to 187 watts in 1911. The tendency for the density of illumination to increase is most marked in the city, and the replacement of low-powered installations by larger units spaced closer together is noteworthy as the stress of business competition is felt more keenly. The first electric sign in the city was installed twenty-two years ago at the Haymarket Theater Mission. In 1910 there were installed for advertising pur-

Fig. 4—View of Curtis and Sixteenth Streets, Denver, at Night.

poses 230,000 cp, and the company is at present installing new signs and enlarging old equipments at the rate of 1000 cp per day. An organization of 700 business men is also taking up the general problem of cross-street special lighting, and the accompanying photographs show what has been accomplished in the illumination of several of the principal longitudinal and lateral thoroughfares of the

business district. Within the past six months the company has installed more 250-watt tungsten lamps for display lighting than it has 100-watt units.

The attractiveness of the flat rate offered by the company for display lighting, combined with the service rendered in connection with such contracts, led to the installation of the following lamps in 1910:

FLAT-RATE DISPLAY LIGHTING INSTALLED IN DENVER IN 1910.

Number of Lamps.	Candle-Power.	Watts.	Type of Lamp.
9,250	4	....	Carbon
205	8	....	"
111	16	....	"
12	25	....	"
181	....	25	Tungsten
104	....	40	"
135	....	60	"
904	....	100	"
11	....	150	"
536	....	250	"
8	....	500	"

The rate for display lighting is based upon a charge of 15 cents per 16-cp lamp per month, plus 5 cents per kw-hour for six hours' service, plus a meter charge of $1. In many cases where the sale of energy on a meter basis for display lighting yields a lower monthly revenue than the flat rate the latter has been accepted by the consumer on account of the convenience of leaving the turning on and off of lamps to the company. It has been found that with the meter rate the tendency is for the merchant to cut off his display lighting too early in the evening, whereas with the flat rate the establishment is certain to utilize its display lighting from dusk to midnight, and sometimes all night, as in certain houses which never close. The flat-rate service permits the merchant to turn on his lamps as early in the twilight period as he desires, regardless of the time at which the company's patrol throws the load into service. The company is beginning to push tungsten sign lighting, the rate being approximately 22 cents per 4-cp tungsten lamp per month, the company furnishing lamps, transformers and connections free and giving free renewals during the life of the flat-rate contract, which is two years. If the contract is then discontinued or a meter installed all the material reverts to the company.

The flat rate is favored on account of its giving the consumer six hours of steady lighting, an assured fixed income to the company derived from energy consumption

Fig. 5—Night View, Showing Special Illumination on One Side of Welton Street, Denver.

lasting far beyond the usual peak, and it benefits the consumer by avoiding any possible disputes on account of meter readings. On metered installations the company averages 65 watts per unit placed in service. The small tungsten sign lamps thus far installed by the company are rated at 11 volts.

Special attention has been given by the company to the design of effective billboard lighting. A representative board is illustrated herewith in connection with the publicity work of the Denver, Northwestern & Pacific Railway, or so-called "Moffat Road," which makes a feature of day trips from Denver over the snow-capped crest of the Continental Divide. The illustration shows a roof board about 20 ft. long and 7.5 ft. high, the colored snow scene

Fig. 6—Night View of Curtis Street, Denver.

depicted being illuminated by six 100-watt tungsten lamps installed in three pairs, a special reflector being provided for each pair. The reflectors are placed about 6 ft. apart on centers at the top of the board, and the lamps are of the 110-volt multiple type. The cost of the service, including renewals, is $9.80 per month for the board, and several other similar installations for the same railway are installed at striking points in the business district and along the main thoroughfares of trolley, pedestrian and automobile traffic. The reflectors are loaned by the lighting company, and a typical unit is illustrated herewith. Each consists of a sheet-iron box, 12 in. x 12 in. x 14 in., with interior lining of white enamel paint, the structure being supported at the end of a hollow pipe carrying the feed wires for each pair of lamps. Another representative "Moffat Road" board is 30 ft. long and is illuminated by eight units of 100 watts rating each, the service costing $14.20 per month less 10 per cent discount. In all installations of billboard lighting special care has been taken to keep the direct rays of the lamps out of the eyes of passers-by. One of the largest boards in the city advertises a trust company and is lighted by ten pairs of 100-watt lamps. The cost of the reflectors complete installed is about $6 each.

An interesting development has recently been made on Welton Street, between Sixteenth and Seventeenth Streets, in the line of display lighting. Twenty-five 250-watt tungsten lamps have been installed on brackets over the sidewalk on one side of the street, the cost of service being $4.50 per lamp per month. The expense is defrayed by abutting merchants, and no other street lighting is required in the block. It is estimated that the above flat rate nets from 6 cents to 7 cents per kw-hour, including three renewals by the company in a period of two years. The accompanying photograph shows the difference between the specially lighted and the other side of the street, and a recent traffic count by the company during the evening rush hours showed that five persons passed along the brighter side of the street to every three people who traversed the darker side.

Another traffic count recently made at the intersection of Sixteenth and Curtis Streets showed that 86,000 people passed between the hours of 5:30 p. m. and midnight. Unquestionably many people passed the spot from two to four times, but the well-lighted windows and the striking sign installations reached them every time. At Fifteenth

and Arapahoe Streets, also in the business district, 43,000 people passed between 5:30 p. m. and 9:30 p. m.; at Sixteenth and California Streets 25,000 people passed in the above hours, and 30,000 passed the intersection of Fifteenth and Welton Streets. Another striking point is the

Fig. 7—Store Front Fitted with Ornamental Wall Brackets.

rapidity with which the public disappears from the streets at midnight as soon as the display lighting begins to be cut off.

It is estimated that Denver uses 100 per cent more candle-power per square foot in window lighting than any other city in America which makes anything of this type of illumination. The small store frequently uses more window lighting than the large establishment, the former being, as a rule, quicker to appreciate the value of lighting after 10 p. m. An interesting example of the drawing power of a well-lighted window was recently given in a small establishment which lighted up a newly dressed window display at 11 p. m. A large crowd collected within a few moments, and the proprietors were quickly convinced that the old practice of cutting off lighting at 10 p. m. or 11 p. m. was a mistake, even though the street for the moment might appear to be occupied by but few passers-by. The amount of window lighting in service in Denver on the flat-rate basis frequently runs from 150 watts to 200 watts per front foot in single establishments. A clothing house with a frontage of only 25 ft. has sixteen tungsten lamps of 250-watt rating installed in window and outside bracket lighting; a prominent jeweler having an establishment of but 13 front ft. has an installation of 120 watts per front foot; a drug house of 80 front ft. has 106 watts per front foot, and two other establishments of 15 front ft. and 14 front ft. respectively have 222 watts

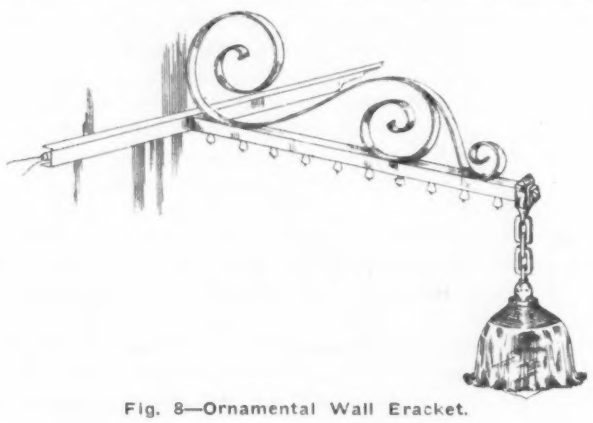


Fig. 8—Ornamental Wall Bracket.

and 214 watts per front foot in nightly service. In the smaller drug stores in residential sections the standards of brilliancy are correspondingly effective. A prominent shoe house with 17-ft. frontage is equipped with four 250-watt lamps in the windows, one 500-watt lamp in the doorway, six 25-watt units in the basement windows and six 16-cp lamps under the shelves. This service costs the consumer about $35 per month on a flat rate.

A novel installation has recently been made at the Broadway store of the Sholtz Drug Company, as shown in the accompanying illustration. The display lighting consists of ten 5-ft. 2½-in. x 2½-in. brackets, each being equipped with ten 4-cp tungsten lamps attached to the under side of the arm, the ends of the brackets supporting one 250-watt lamp. The brackets are installed about 6 ft. apart and have proved a striking success in drawing trade. The window lighting of this establishment is also carried out on a plane comparable with the external illumination. Another branch of this house has lately installed a revolving sign operated by a ½-hp motor, the sign making one complete turn every twenty-eight seconds and advertising the store to all parts of the compass with a minimum consumption of energy and small investment in equipment. The sign is located on the roof of the store and is visible for several blocks along the main trunk lines of travel near the State Capitol.

Besides the outline lighting of the company's building elaborate installations of incandescent lamps for this service have been made at the principal moving-picture theaters of the city. The bills for display lighting in some of these cases run from $25 to $50 per week. At present the company is in conference with the Daniels & Fisher Stores Company preparing for the spectacular illumination of the famous campanile lately erected by that house at the intersection of Sixteenth and Arapahoe Streets. The tower rises to a height of about 380 ft. above the sidewalk and is already a conspicuous object at night on account of the light reflected upon it from the Gas and Electric Building. Plans are also in contemplation for the illumination of the new Shubert Theater offices by upward of 1700 lamps, including 5-watt units for the outlines of the main arch, 20-cp lamps in linolite installation for the coping and 60-watt units behind art-glass shades in the cornice. Great interest has been aroused in outline lighting as a result of the initial illumination of the company's building, and it is anticipated that within the next few years this form of illumination will become general among the more progressive establishments. The amount of outline lighting which can be handled through the use of tungsten lamps of moderate candle-power is surprising when expressed in terms of connected load. The problem of lamp replacement has been worked out by the Denver Gas & Electric Light Company along the lines of an electric telpher with motor-driven elevator cage which will travel around the outside of the building and reach every lamp through a system of push-button control operating the telpher longitudinally upon a track supported on the roof and raising and lowering the cage as conditions demand. The telpher will probably be installed during the coming fall.

The work of the illuminating engineering department is

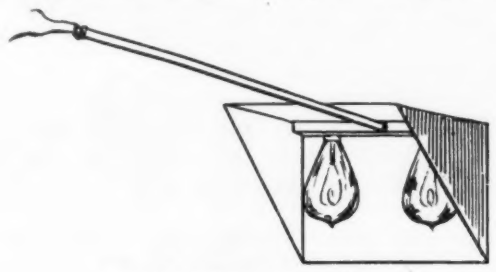


Fig. 9—Billboard Reflector.

carried on under the supervision of Mr. George E. Williamson, reporting to Mr. Clare N. Stannard, secretary and commercial manager of the company. Mr. C. F. Oehlman was associated with Mr. Williamson in the design of the illumination of the company's building, which was first occupied near the close of last year.

LETTER TO THE EDITOR.

Electric Lighting from Three-Phase Circuits.

To the Editor of Electrical World:

SIR:—Referring to the article in your issue of Aug. 5 by Mr. G. P. Hoxie on "Electric Lighting from Three-Phase Circuits," and applying to the lighting in industrial plants, the following arrangement for circuits of 440 volts or 550 volts, three-phase or higher, will be found very satisfactory.

Each lighting feeder is sectionalized at its center of distribution; two three-phase to two-phase transformers are installed with the secondary of each connected to a section of the feeder. If it is desirable to use three-wire feeders the transformers should have 220-volt and 110-volt secondaries. This arrangement simplifies the wiring and phases are not likely to become unbalanced.

Atlanta, Ga. H. A. COLES.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Overload Capacity of Induction Motors.—E. AUERBACH.—The author gives a simple approximate formula for the overload capacity of an induction motor which can be used when the results of the no-load and short-circuit tests are known. The overload capacity u is defined as the ratio of maximum torque to normal torque. The formula is

$$u = f\,\frac{i_k + i_o}{2\,i_1}$$

where f is a safety factor, generally = 0.9, while i_1 is the full-load current, i_o the no-load current and i_k the short-circuit current.—*Elek. Zeit.*, July 27.

Braking Induction Motors.—A note on a recent British patent (17,010, Aug. 3) of E. Rosenberg and J. S. Peck. In the braking of induction motors, where the motor is disconnected from the alternating-current supply and one of the windings is supplied with direct current, means are provided for a resistance, placed in circuit with the other winding, to be varied automatically by a device which operates in accordance with the motor speed as a generator or with the frequency or voltage of the current generated by the secondary member of the motor.—Lond. *Elec. Eng'ing*, Aug. 10.

Direct-Current Armature Windings.—R. RANKIN.—An article illustrated by diagrams in which the author explains how the properties of lap and wave windings may be demonstrated, and how it may be proved by a simple diagram exhibiting the conductors arranged and numbered consecutively that the usual formulas for simple windings of the kind mentioned are correct.—Lond. *Elec. Review*, Aug. 11.

Lamps and Lighting.

Photometric Flame Standards.—W. J. A. BUTTERFIELD, J. S. HALDANE AND A. P. TROTTER.—The authors describe apparatus which they have used for determining the effects of variation of pressure, degree of humidity and atmospheric vitiation on the candle-power of the Harcourt pentane and the Hefner amyl-acetate lamps. As a result of these experiments curves are given which in the case of the Hefner lamp show that Liebenthal's formula for corrections for barometric height does not rest on acceptable data. In conclusion, general correction formulas for both lamps are given. Fig. 1 gives the effect of variation of atmospheric pressure on the luminous intensity of the Harcourt and the Hefner lamps. The curves show that the relation between atmospheric pressure and the yield of light is not constant or expressed by a straight line. The falling off of the light with reduction of pressure is much greater at the lower than at the higher pressures. The curve for the Harcourt lamp is, however, nearly a straight line for the range of 700 mm to 850 mm, and shows that within these limits the light increases or decreases by 1 per cent with an increase or decrease respectively in pressure of 12.5 mm or that a variation of 10 mm in pressure is attended by a variation in the same sense of 0.8 per cent in the light afforded by the lamp. The curve of the Hefner lamp is likewise nearly a straight line for the range of 700 mm or 850 mm, and shows that

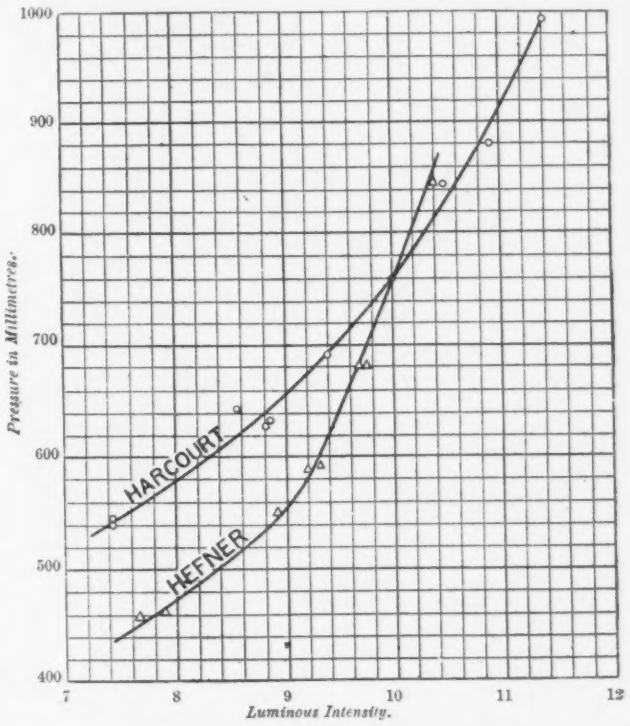


Fig. 1—Effect of Variation of Pressure.

within these limits the light increases or decreases by 1 per cent with an increase or decrease respectively in pressure of 25 mm, or that a variation of 10 mm in pressure is attended by a variation in the same sense of 0.4 per cent in the light afforded by the lamp. Experiments were also made to determine the effect of variations in the humidity of the air on the light. The results show that the light of both the Harcourt and Hefner lamps decreases by 1 per cent for an increase of 0.16 per cent in the aqueous vapor in the air, or that an increase of 1 per cent in the aqueous vapor in the air is attended by a decrease of 6.25 per cent in the light of the lamps. Finally experiments are described in which the effect of different degrees of vitiation of the atmosphere on the light of the standards was determined.—Lond. *Electrician*, Aug. 11

Generation, Transmission and Distribution.

High-Pressure Water-Power Works.—L. ZODEL.—A paper read at the Zurich meeting of the (British) Institution of Mechanical Engineers. The author first indicates the method employed in classifying water-power plants into high, medium and low heads, and the conditions

which make the choice of any of these desirable, and when storage reservoirs should be included. A number of recent high-head hydroelectric stations and the more interesting points in the design of their pipe lines are then described. The water-carrying system of a high-head hydraulic power scheme consists of two parts, the low-pressure part to cover most of the horizontal distance between the lake or river intake and the power house, and the high-pressure part to give the operating head for the station. The high-pressure pipe line represents one of the most costly items of the plant, and is, therefore, made as short as possible by taking the low-pressure conduit to the nearest advantageous point above the power house. There are two main types of this conduit, that in which water flows under pressure and that with water flowing freely in an open flume. The former may be subdivided into (1) the pressure-tunnel arrangement leading to a deep penstock chamber, as in the case of the Tyssedalen and Brusio installations, and (2) the low-pressure feeder-pipe arrangement connecting to a receiver with a stand-pipe, as at Necaxa and Rio de Janeiro. Both of these systems allow the total head available at any time in the reservoir to be utilized even with large variations in water level. The type of conduit with open flume cannot, however, utilize any head in the reservoir and this must be lost. In the case of a long conduit a balancing reservoir must also be constructed to provide for any sudden increase in the load, since the open flume will not draw a greater volume of water to supply a greater demand, as happens automatically with the pressure conduit. This case is illustrated in the Siagne power station. Another example is the well-known Kinlochleven plant of the British Aluminum Company, in Scotland. The choice of the arrangement of conduit most suitable for a power scheme depends entirely on the particular conditions of the works and no rule can be laid down.—Lond. *Electrician,* Aug. 11.

Traction.

Electric Traction on Main Lines and Interurban Roads in Europe.—F. Stein.—Highly elaborate statistical tables on the status of electric traction in June, 1911, on main roads and interurban roads in various European countries. For each road a very large amount of information on general conditions, equipment of road and rolling stock, details of electrical equipment and operation, literature, references, etc., is given in forty-four separate columns. The statistics comprise twenty direct-current lines and ten single-phase lines in Germany, ten direct-current lines and seven single-phase lines in Austria-Hungary, nine direct-current lines and five single-phase lines in France. The German statistics are given in *Elek. Zeit.,* July 27, and the Austrian and French statistics are given in *Elek. Zeit.,* Aug. 3.

Electric Traction on Trunk Roads in Germany.—The following main-line sections in the Province of Silesia are to be equipped electrically: From Laubau to Hirschberg and Dittersbach and Königszeit, 123 km (74 miles); from Hirschberg to Grüntal 50 km (30 miles); from Hirschberg to Schmiedeberg and Landeshut, 40 km (24 miles); from Ruhbank to Liebau, 16 km (10 miles), and from Niederalzbrunn to Halbstadt, 34 km (20 miles). These are mountain roads, with grades of 2 per cent and 2.5 per cent, the smallest radius of a curve being 188 m (617 ft.). Energy will be bought from a private company, which will erect the power plant and substations. Two types of electric locomotives will be used, one for passenger trains with a maximum speed of 110 km (66 miles) per hour, the other for freight trains with a maximum speed of 65 km (39 miles) per hour. (Since it is stated that the freight locomotives will be practically identical with those of the Dessau-Bitterfeld line, it follows that the single-phase system is to be used.)—*Elek. Zeit.,* July 20.

Installations, Systems and Appliances.

Marseilles.—A long and fully illustrated description of the central station of Marseilles, in France, where direct current and alternating current at two different frequencies and voltages are generated to meet the requirements of the varying needs of the district. Energy from the steam-turbine plant is supplied to the city system at 5500 volts and a frequency of 25 cycles. This is transmitted to a large substation from which the central district is supplied. From this substation direct current at 220 volts is delivered to a three-wire network. The station also supplies current at 5500 volts and a frequency of 50 cycles to the outlying districts. Low-tension mains on the alternating system are fed from small transformer posts placed at various points, the secondary voltage being 190 volts in this case. For industrial service, especially for large motors, the company is operating a special system, using a pressure of 13,500 volts delivered directly from the machines at the central station, a frequency of 25 cycles being used. The high-tension lines owned by the company have been laid out so that in case of need they can be supplied with energy from the network of 13,500-volt lines which covers the Maritime Alps region and runs as far as the large substation of Allauch, in the neighborhood of Marseilles. This system is the most extensive in France and is fed from a number of hydraulic plants lying in the mountain region. It can be drawn upon if required, and, inversely, the Marseilles station can feed into the Allauch substation, so as to afford a reserve supply for the latter. In order to satisfy the above-mentioned conditions the Marseilles plant has been arranged to furnish energy at three voltages and frequencies. Energy is produced by three 1000-kw turbines at 5500 volts, three-phase, and a frequency of 25 for the supply of the central substations of Marseilles. For the transformer posts in the outer districts of the town energy is obtained from one 1000-kw turbine. While the voltage in these districts is the same as that in the center of the town the frequency is 50 instead of 25. For interchange purposes a frequency changer consisting of a 50-cycle motor and a 25-cycle alternator is used. Either one of these machines can act as a synchronous motor so as to operate the other as an alternator and thus produce energy at either of these two frequencies if required. For the supply of the high-tension lines a turbine which delivers three-phase energy at 13,500 volts and a frequency of 25 cycles is installed. In the station there is also a set of transformers having a ratio of 13,500 to 5500, so that the high-tension energy can be fed to the 5500-volt bars or vice versa. Care has thus been taken in laying out the station to make the above three systems interchangeable, and any one of the five turbine groups can be used to supply any of the circuits of the station in spite of the different voltages and frequencies.—Lond. *Electrician,* Aug. 11.

Domestic Uses of Electricity.—G. Dettmar.—The concluding part of his very long paper presented before the German Association of Electrical Engineers. In the present instalment the author deals with the use of the electric motor for driving elevators, washing machines, ventilators, sewing machines, refrigerating machines, etc., and also deals with the use of electric bells and clocks. To

	Mean Price of Kw-hour.	Number of Residences Connected.	Kilowatts Connected.	Kw-hours Sold During the Year.
1906	12 cents	246	657	85,859
1907	9 cents	946	885	143,897
1908	9 cents	1,538	1,281	237,180
1909	9 cents	2,271	1,744	367,801
1910	9 cents	2,673	2,027	511,112

encourage the domestic uses of electricity an energetic propaganda by the central stations is necessary, together with the introduction of a fair rate. In Erfurt the consumers are divided into different groups according to their requirements, and this has led to a considerable increase in the use of electricity in residences, as shown in the table on the preceding page.

It is possible to reduce the cost of electricity for the consumers without detriment to the station. Thus in Cologne (where a double rate is used) the number of kw-hours sold has increased very essentially, while the maximum load of the station has increased only slightly.—*Elek. Zeit.*, July 27.

Electrophysics and Magnetism.

Temperature Coefficients of Electrical Resistors.—A. A. SOMERVILLE.—The third paper of his serial. The author has now tested various metals and commercial resistor

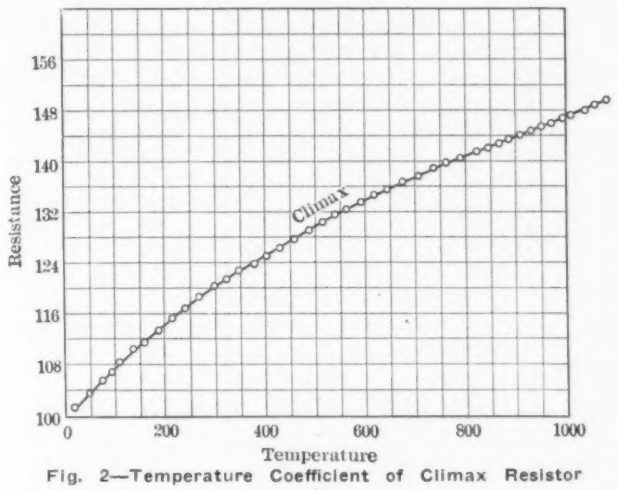


Fig. 2—Temperature Coefficient of Climax Resistor Metal.

alloys. Fig. 2 gives the curve for the commercial resistor alloy "climax"; Fig. 3 gives the results for metallic silicon and the resistor alloys "cupror" and "phosphor bronze"; Fig. 4 gives the results for the Krupp resistance alloy, for German silver and for "monel metal." Curves are also given for tin, brass and zinc. In the case of the pure metals, zinc and tin, having comparatively low melting points, the interesting feature is the change of resistance that takes place when the specimen passes from a solid to a liquid state and vice versa. Another interesting feature about zinc is that if it is drawn into a very fine wire and wrapped in the form of a spiral about a quartz tube the surface tension of the molten zinc is sufficient to hold it together for a considerable further increase in tempera-

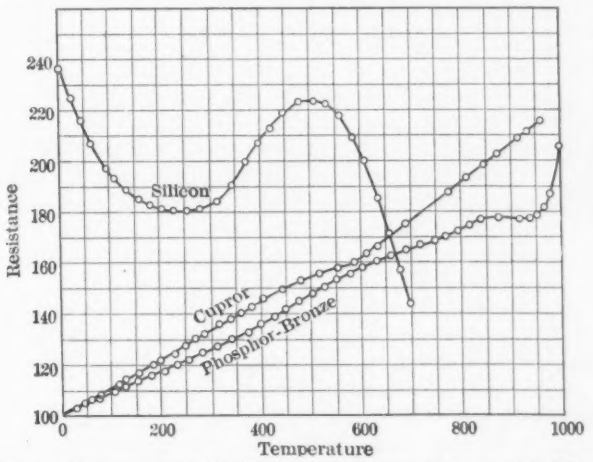


Fig. 3—Temperature Coefficient of Silicon, Cupror and Phosphor Bronze.

ture, and during this further heating the temperature coefficient of resistance is quite unusual, without doubt being negative and quite uniform for more than 100 deg. before the thread of zinc pulls apart. On the other hand, if the zinc is drawn into a small quartz tube as a containing vessel and its resistance measured there, the coefficient while molten is almost zero.—*Phys. Review*, July.

Alternating-Current Resistance and Induction of Coils.—A. ESAU.—The skin effect increases the resistance and reduces the inductance of coils. The investigation of the author shows that for single-layer coils the formula of Wien and that of Sommerfeld represent correctly the increase of resistance for frequencies up to 6000 periods per second. For multiple-layer coils the experiments undertaken are incapable of deciding between the two formulas. Both appear to be fairly correct for small frequencies and for a large number of layers. For the higher frequencies (4000 to 6000) the resistances fall below the calculated values, especially when there are

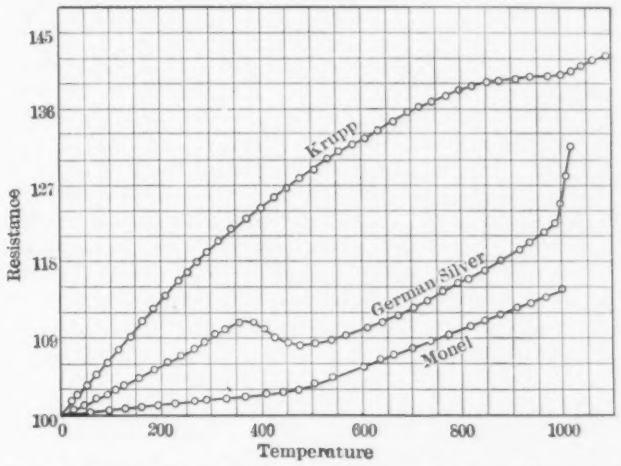


Fig. 4—Temperature Coefficient of Krupp, German Silver and Monel Metals.

only a few layers (two or three). As regards the inductance, it is found to change least when the coil is long and the number of layers is large.—*Ann. d. Physik*, Vol. 34, pages 57 and 547, 1911; Lond. *Electrician*, Aug. 11.

Delta Rays.—N. CAMPBELL.—A long account of an extended investigation. The chief results may be summed up as follows: There is no evidence that the speed of the delta rays is dependent on the speed of the alpha rays exciting them. There is no evidence of any difference in speed between the emergence and incidence radiations. The incidence radiation appears never to be less than the emergence, though it is sometimes not greater. It is doubtful whether the speed of the delta rays varies with the material from which they are emitted. There is no evidence that the number of the delta rays emitted depends on the material from which they are emitted. There appear to be true delta rays emitted from the active substance emitting the alpha rays in excess of those due to the impact of those alpha rays on the support.—*Phil. Mag.*, August.

Electrochemistry and Batteries.

Power-Factor and Load-Factor in Electric Furnaces.—J. HARDEN.—The author emphasizes the effect of power-factor and load-factor upon the first cost of an installation of an arc and induction furnace plant and also upon the operating costs. The author concludes that from the electrical engineer's point of view, apart from the requirements of metallurgists, neither the induction furnace, as such, nor the plain arc furnace work under ideal conditions, the former because of its lower power-factor and the latter for the reason of its unsteady load. The author recommends a combination of the good features of both—that is, the higher power-factor of the arc furnace and the high and steady load-factor of the induction furnace in a new furnace design.—Lond. *Electrician*, Aug. 11.

Edison Storage Battery.—F. H. COLVIN.—A profusely

illustrated paper in which the author describes the various mechanical methods used in the manufacture of the Edison storage battery. A description is given of the different steps in the methods of making the sheet-steel grids, the tubes for the positive element and their filling with nickel flake, the making of the flat pockets for the negative element and their filling with iron oxide, the production of nickel-flake 0.00005 in. thick by electrolytically depositing alternate layers of copper and nickel and leaching the copper out, and finally the manufacture of the battery cases and the cutting of hard rubber for insulation. The many different steps of these processes are explained with the assistance of numerous illustrations.—*Amer. Machinist*, Aug. 10.

Units, Measurements and Instruments.

Units and Notations.—The committee on units and notation of the German Association publishes four proposals. The first deals with the definition of work (Arbeit) and energy, which should be more clearly distinguished in future. The second deals with the definition of Durchflutung und Strombelag. Elektrische Durchflutung (electric flux) is the algebraic sum of all electric currents through any area. In the case of a two-dimensional electric flux (through a film or foil) the current or the electric flux through a unit of length perpendicular to the lines of current is called the "Strombelag." The third proposal gives a list of often recurring signs of notation, for instance, %, v. H for per cent, o/oo, v. T for pro mille, etc. One proposal which differs essentially from American practice is to use the sign ÷ instead of "to" in phrases like 3 ÷ 4 hours for three to four hours, i. e., a time between three and four hours. The fourth proposal is to find a substitute for horse-power. "The technical unit of power is called the kilowatt or newhorse (Neupferd). It is practically = 102 kilogrammeters per second and corresponds to the absolute power of 10^{10} ergs per second. Unit *NP*." The following conversion factors are given (where horse-power is here written instead of the German *PS*):

1 *NP* = 1.36 hp = 102 kilogrammeters per second.

1 hp = 0.735 *NP* = 75 kilogrammeters per second.

1 kilogrammeter per second = 0.0098 *NP* = 1.33 hp.

Discussion of these proposals is invited to the middle of January, 1912.—*Elek. Zeit.*, July 20.

Dynamometers.—A. Amsler.—An abstract of a paper presented at the Zurich meeting of the (British) Institution of Mechanical Engineers. The author described two types of dynamometers, one of which is suitable for high-speed and the other for low-speed machines. The former of these is of the torsion type and consists of three disks, one at one end of the shaft whose torque is required and the other two at the other end. The first disk is provided with a transparent circumferential celluloid scale, which can be observed from the third disk through a fine slit in the second. This fine slit acts, in fact, as a pointer, and the amount of torsion can thus easily be read off when the scale is illuminated by a 50-cp lamp. Provided the shaft be perfectly elastic the angle through which the extreme ends are turned will be proportional to the twisting moment—that is, proportional to the power transmitted. If the shaft is made of a special spring steel of very high yield point—that is, above 6000 kg per square centimeter (90,000 lb. per square inch)—it can be twisted to a considerable degree without breakage or permanent distorsion. In the example given the twist of the rod, 40 cm (15/34 in.) long, is for a twisting moment of 20 m-kg (1736 in.-lb.), about 20 deg. The shaft has a cross-section of 12 mm x 12 mm (0.4725 in. by 0.4725 in.), and is, therefore, subjected to a stress of 5200 kg per square centimeter (78,000 lb. per square inch), which is below the yield point. In the second type of instrument a pulley is provided with two projections, which when in rotation press a small piston into a cylinder filled with oil. This causes a registration proportional to the torque to be given on a gage through a mechanism similar to that of an ordinary steam indicator. A strip of paper passes under the pencil of a registering gear at a velocity proportional to the speed of the shaft of the instrument. The area of any portion of the diagram thus obtained represents the energy absorbed by the machine and the mean height the average power transmitted.—Lond. *Electrician*, Aug. 11.

Localization of Faults.—E. Caudrelier.—The author describes a simple method which enables one to determine at

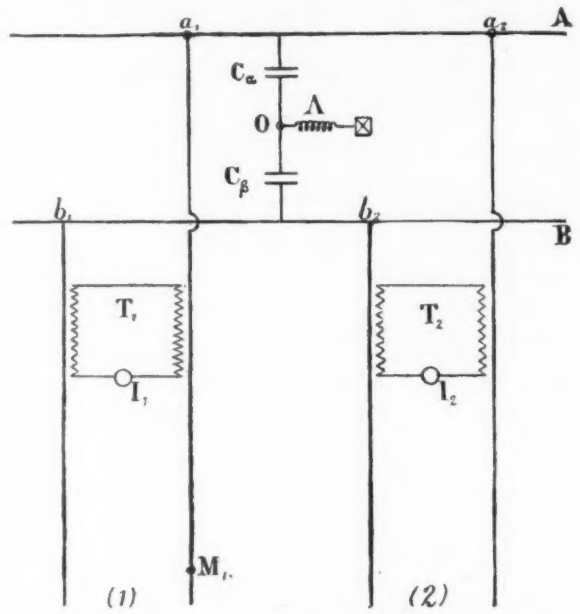


Fig. 5—Diagram of Connections for Localization of Faults on Feeders.

once in which of a number of feeders radiating from a generating station a fault has occurred. *A* and *B* in Fig. 5 are the main busbars. A neutral point *O* is obtained by connecting two equal condensers *Ca* and *Cb* across the busbars. The point *O* is connected through a self-inductance *A* with the earth. Each wire of a feeder represents the primary of the transformer *T*, the secondary of which is connected with the secondary corresponding to the return wire of the same feeder. In normal condition the two emfs are opposite and the needle of the instrument *I* is at rest. If on the feeder 1 a fault occurs, for instance, at M_1, the instrument I_1 will always indicate it.—*La Lumière Elec.*, July 1.

Expression of Resistivity of Electrical Conductors.—J. H. Dellinger.—The author discusses the desirability of expressing resistivity as "mass resistivity" rather than volume resistivity, the chief reasons being that mass is more easily measured than cross-section and conductors are sold by weight rather than volume. The author endeavors to show: (1) that "ohms per meter-gram" is well established as a unit of resistivity; (2) that from a practical standpoint the "mass resistivity" is preferable to the "volume resistivity"; (3) that the advantage of a mental picture to aid in defining volume resistivity is no less available in defining mass resistivity; (4) that "specific resistance" is an undesirable term; (5) that the term "resistivity" is susceptible of a certain breadth of definition, and (6) that there are limitations to the proper use of "per cent conductivity."—Lond. *Electrician*, Aug. 11.

Mercury Motor Meter.—W. Kesseldorfer.—A long illustrated paper read before the German Association (Verband) of Electrical Engineers, giving a sketch of the theory and a historical review of the different types of mercury motor meters and details of the construction of the latest meter of the Isaria Company.—*Elek. Zeit.*, July 13.

BOOK REVIEWS.

ENERGY, WORK, HEAT AND TRANSFORMATIONS. By Sidney A. Reeve. New York: McGraw-Hill Book Company. 238 pages. Price,

An elementary textbook on energetics written from the standpoint of a teacher on engineering concepts as a substratum. Formal mathematics are sparingly used, yet the train of thought is essentially quantitative, although tinged with a certain realistic philosophy. The book will be useful to engineers who, not having gone to college, desire to become acquainted with the fundamental principles of heat and energy without delving too deeply into mathematics.

THE LAW AND COMMERCIAL USAGE OF PATENTS, DESIGNS AND TRADEMARKS. By Kenneth R. Swan. New York: D. Van Nostrand Company. 386 pages. Price, $2.

A descriptive treatise of patents and patent law, especially from the British standpoint, for the use of inventors and the public. The book is clearly written, logically arranged, well indexed and not too technical. It will be useful to American inventors interested in the details of British patents and patent practice.

New Apparatus and Appliances

ACETYLENE WELDING AND CUTTING MACHINE.

An acetylene welding and cutting machine recently built by the Davis-Bournonville Company, of 90 West Street, New York City, at its laboratory at Marion Station, Jersey City, is shown in the accompanying illustrations. The machine can be used in sheet metal work where the thicknesses range up to 3/16 in. or 7/32 in. and for straight cutting of both thin and thick work, to which it is particularly adapted because of the precision of the movement of the machine.

A cylindrical upright about 6 ft. in height carries a hollow horizontal arm projecting at right angles for 6 ft. or 7 ft. and adjustable in height by means of a rack and pinion. The arm in turn carries a long screw mounted in suitable bearings. At the base of the upright loose and tight driving pulleys are mounted on a short horizontal shaft, at one end of which is a friction pinion which engages with a disk mounted on a vertical shaft. This shaft and a rotatable rod in the hollow arm are put into driving connection by bevel gears. At the outer end of the arm an arrangement of gears enables the inclosed rod to drive the screw, the turning of which operates a traversing carriage upon which the torch and its controlling fixtures are mounted, as shown in Fig. 1. The work is secured on a fixed table and flexible tubes bring oxygen and acetylene to the torch, which is arranged at an angle of about 45 deg. to the horizontal and moves over the work much after the way of a traversing tool.

If a weld is to be a flat one the two pieces are simply clamped in the exact relative positions they are to occupy finally, room being left between clamps for the tip to pass. In welding the carriage with the torch moves evenly along at a proper rate of speed. The countershaft, running at, say, 140 r.p.m., operates the short horizontal shaft at about 70 r.p.m. It is possible to adjust the friction pinion to vary the angular speed of the vertical shaft from about 75 r.p.m. to about 35 r.p.m. Still further reductions of speed may be made by the gears at the end of the arm. For an angular weld the two strips are placed edge to edge at the proper angle on the sides of an angle bar and secured in position with clamping strips inserted between the outer faces of the work and the jaws of the clamps.

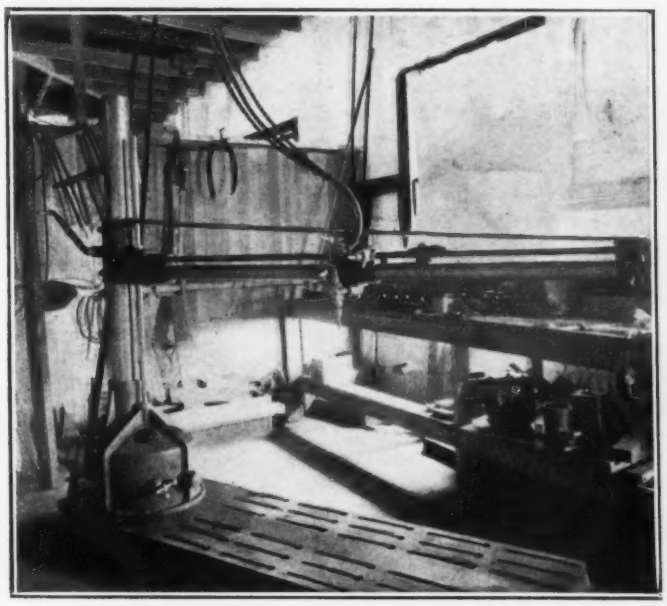


Fig. 1—Machine Equipped for Welding.

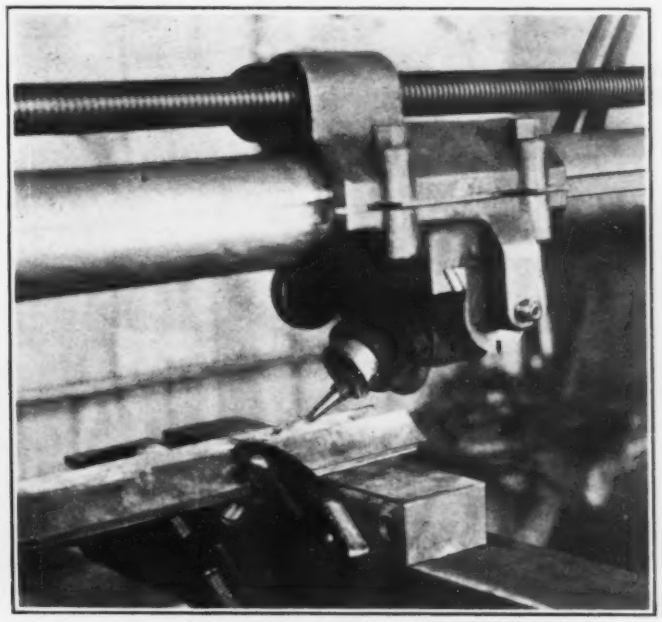


Fig. 2—Arrangement for Angular Work.

Because of the enormous temperature of about 6000 deg. Fahr. which is claimed for the working point of the oxy-acetylene flame, the torch brings steel and other metals locally to or near the melting point. An ordinary flame may, however, supply a large amount of the requisite heat where the form and character of the work do not prohibit. The methods of preheating may be various. With small repetition work the preheating may in some cases be done subsequent to clamping but prior to putting the work on the table, while other cases will require preheating with the work in welding position.

The machine above described as a welding device can readily be used as a cutting apparatus with a different arrangement of jets. Three jets are arranged in a rigidly vertical position in line with the direction of movement. Ahead is a heating jet of oxygen and acetylene; at the rear is another but smaller heating jet. Between the two the cutting jet of oxygen is arranged. An oxygen and an acetylene tube together supply the gases for the two heating jets and an independent oxygen supply is provided for the cutting jet, for the reason that ordinarily the pressure back of this jet is higher than required for the heating oxygen. The forward jet, which provides preliminary heat for the metal, is ⅜ in. ahead of the pure oxygen jet. The rear jet provides additional heat to make up for dissipation by conduction. In the case of thin plates the rear jet may be shut off.

LONG-LIFE FLAME-ARC LAMPS.

The new type "K" long-life flame-arc lamps recently developed by the General Electric Company are of the vertical-electrode type for operation on series and multiple alternating-current and multiple direct-current lighting circuits and on direct-current motor circuits of all standard commercial voltages.

The mechanism is of the focusing type, designed to maintain the arc in the same position and thus afford a constant and even distribution of the light. A new form of clutch permits the use of electrodes varying considerably in diameter, thus obviating all troubles due to the wear on clutch jaws and insuring a perfect feed. In order to prevent the arc from flickering where the lamps are subject to excessive vibration the cores and coils are suspended by means of compression springs. Except in the case of the series lamps no shunt spools are used, thereby eliminating a prolific source of trouble in arc lamps. The dimensions of the electrodes—⅞ in. diameter and 14 in. long—give great mechanical strength and a corresponding reduction in loss by breakage in handling, while their homogeneity affords many advantages over cored electrodes. It is necessary to renew only one electrode at each trim, the stub of the upper electrode being utilized in the lower holder, thereby obtaining a marked reduction in the cost of maintenance.

The lamp is provided with two globes, an inner globe of either clear or opalescent glass held tightly against the machined surface on the under side of the condensing chamber by a phosphor-bronze bail spring, thus making an air-tight joint, and an outer globe furnished in opalescent glass on the standard lamps, but which may be obtained of clear glass if desired.

The method of securing the globe which is in use with this lamp simplifies and facilitates the work of trimming. The complete globe holder is hinged to the condensing chamber, and to lower the outer globe for trimming it is only necessary to loosen the wing-nut and allow the globe to swing downward, where it is out of the way and not liable to be broken by swinging in the wind and hitting the pole.

The principle of ventilation applied causes the hot gases to rise from the arc and circulate through the condensing chamber, where they are cooled and the fumes condensed and deposited, thus keeping the inner globe clean and the illumination unimpaired.

In operation the arc voltage on the multiple alternating-current lamp is regulated by a reactance, on the multiple direct-current lamp by a resistance and on the motor-circuit lamp by a resistance and a weight for properly balancing the arc voltages when two lamps are burning in series. All the lamps have their respective reactance or resistance located inside the lamp casing. The clutch rod regulates the distance from the top of the armature to the clutch lever.

The series alternating-current type has a consumption of 0.20 watt per mean hemispherical candle-power and the multiple alternating-current and the multiple direct-current types have consumptions of 0.28 watt and 0.41 watt respectively. The series lamps have a life of from 90 hours to 100 hours, while the multiple lamps have a life of from 100 hours to 120 hours, thus combining high efficiency with long life.

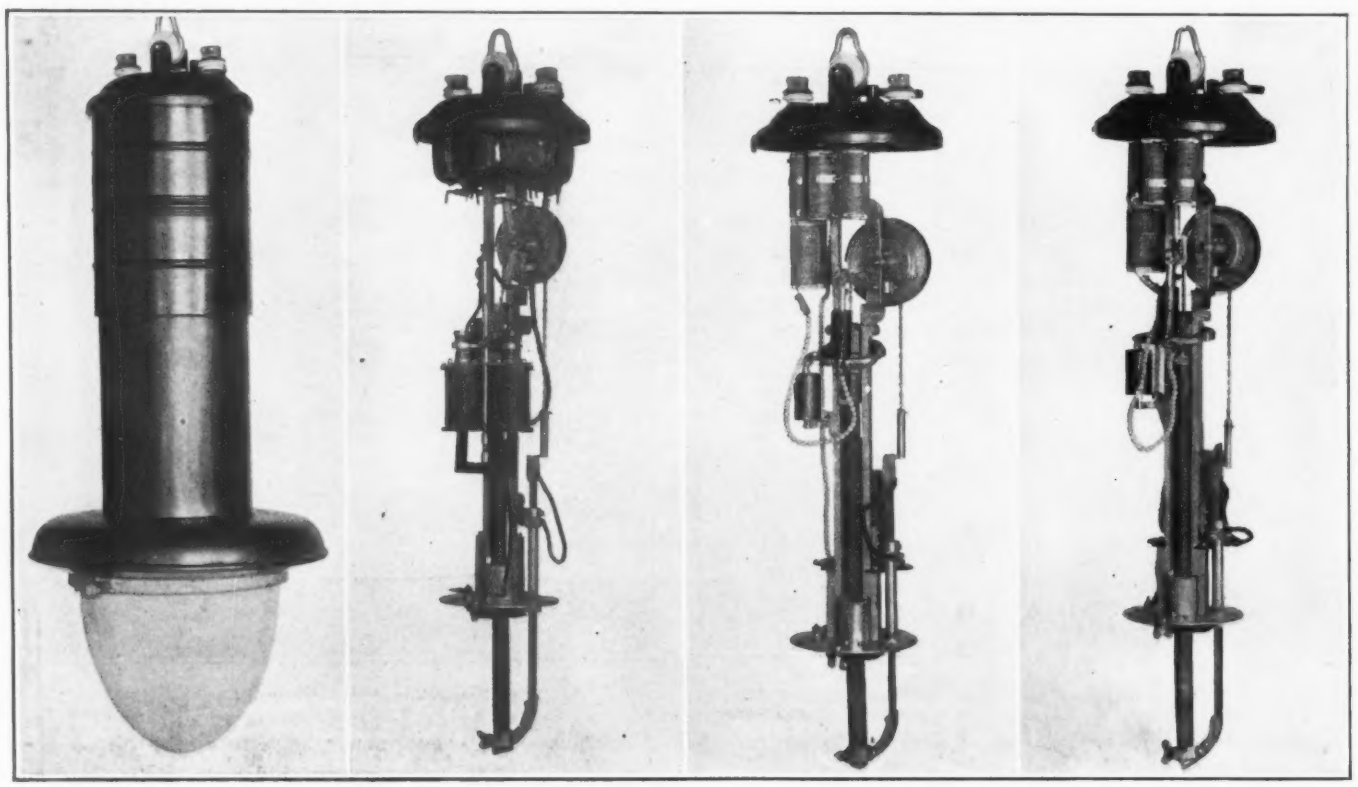


Fig. 1—Long-Life Flaming-Arc Lamps for Multiple Alternating and Direct Current Service.

GOOD SWITCHES VERSUS POOR SWITCHES.

By Granville E. Palmer.

In electrical installations each article should be analyzed as to its good and bad points in cost, construction and durability. In this connection the flush push-switch problem is often overlooked and the cheapest article is often selected with bad results. Push-button switches have been in use about eighteen years, and their design and construction have followed two very plainly marked lines, one in which the manufacturer insists upon the best construction experience has developed and the other in which the manufacturer has sharpened his wits to produce a switch at a lower cost than the other manufacturer, to the end that he might either make an excessive profit or be in a position to dominate the switch market on a price consideration. The first class of manufacturer has succeeded in establishing a reputation for thoroughness that makes his product a standard throughout the world. The reputation of the other type of manufacturer who is able to produce fair goods at a ridiculously low price is equally well known.

Due to the fact that standard dimensions are essential in the manufacture of push-button switches, good and bad switches have the same general appearance when hidden by a plate, and to the lay mind present no very great points of difference as long as they continue to operate, and when they fail to operate usually produce a general criticism of things electrical rather than a mechanical analysis that would result in a determination of the cause of the trouble.

Complaints are often lodged against non-operating switches, and in the majority of cases defective operation is due to poor insulation, badly designed or carelessly assembled mechanism, or corrosion due to excessive dampness. Considerable difficulty is often experienced in switches presenting an open pocket into which plaster, paint, etc., can lodge during the period of building construction before the plate is installed, and it is remarkable that there is but one manufacturer who is offering a switch in which this important point has not been quite overlooked.

Practically all the cheap switches on the market are insulated with fiber and the mechanism supported on a grounded metal strap. Fiber, being a ready absorbent of moisture, has been condemned as an efficient insulating material, and when it is admitted that the majority of switches on the market are so insulated it is remarkable that the very general demand for a more satisfactory article is so often sidetracked by a consideration of the matter of price.

The moisture that causes a breakdown of insulation also seriously affects the mechanism of the switch, and when steel parts are protected by a thin brass or copper deposit it is not surprising that they readily disintegrate under normal operating conditions, and when placed in damp walls or basements go to pieces very quickly. It is a simple, but nevertheless expensive, operation to treat the metal parts of a switch so that they will not rust, and if the interested purchaser will assure himself on this particular point and insist upon material in which this difficulty is provided for by careful manufacture, one of the most vexatious troubles that arise in push-button switch maintenance will be overcome.

Clean sheet mica, free from impurities, is one of the best known insulating materials, and when so supported that the action of the switch will not cause it to disintegrate mechanically it offers a ready but somewhat expensive method of insulating push-button switches, and is used exclusively by all manufacturers of good switches. In addition to insulating the current-carrying parts of the switch from its spring-operating mechanism it is also considered excellent construction by good switch manufacturers to support the switch mechanism on its porcelain base rather than on the metal support by which the switch itself is suspended, thus giving a double insulation between current-carrying parts and ground.

There is no reason why push-button switches should not be installed with the idea that they will last as long as the building in which they are placed, and the writer is confident that this opinion is fully borne out by the reputation that has been earned by certain good push-button switches that have been on the market as long as a demand was first created for material of this character.

A superficial student of mechanical devices is more frequently impressed with the novelty rather than the practical utility of a device which he may be considering with a view to purchase, and certainly novelty has not been lacking in push-button switch design. It is not the writer's intention to criticise the interest which all good mechanics show in novel devices, as the development of all mechanical structures has been due to the imagination and initiative of some person trying to improve on old-fashioned methods, but frequently a novelty designed to overcome an alleged difficulty will produce more trouble than even the imagination of its inventor could attribute to a standard article.

BATTERY GANG SWITCHES.

A new front yoke which is used to assemble gangs of Cutler-Hammer battery switches can be stamped in long strips so that gangs 1 ft., 2 ft. or 1 yd. or more can be assembled without any difficulty in aligning. To separate into single units or two, three or four-gang units it is only necessary to use a nipper or hack saw. The new busbar, which is shown in the rear view, is also stamped in long lengths.

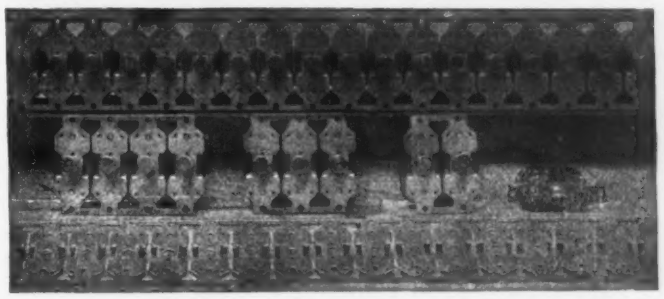


Fig. 1—Front View, Showing Front Yoke.

This arrangement eliminates the work of running a wire across the backs of the several switches and provides a neater and more secure connection. The new washers used are cupped so that any size stranded wire from No. 18 to No. 10 can be securely held without solder. Standard front yokes and busbars are in four-gang lengths. These features cut down to a minimum the work and time of installing, and make it possible for the jobber or dealer to supply single units or gangs of any size from a minimum stock. The face plates are furnished separately by the manufacturer.

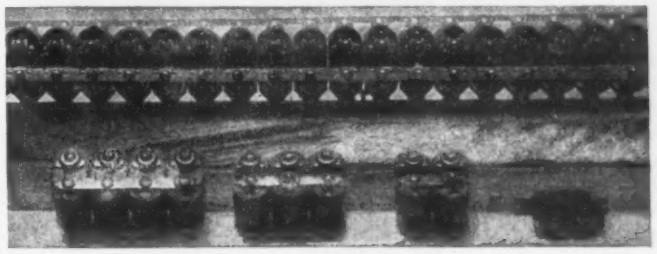


Fig. 2—Rear View, Showing New Busbar Connection.

LOW-VOLTAGE TUNGSTEN LAMPS.

The availability of tungsten in the form of drawn wire, having a tensile strength exceeding even that of piano steel, has greatly extended the field of application of tungsten lamps. An important class of service thus included is that of automobile and railroad-train lighting, in which the effects of shock and vibration are maximum, and which, therefore, require the use of lamps having sturdy filaments.

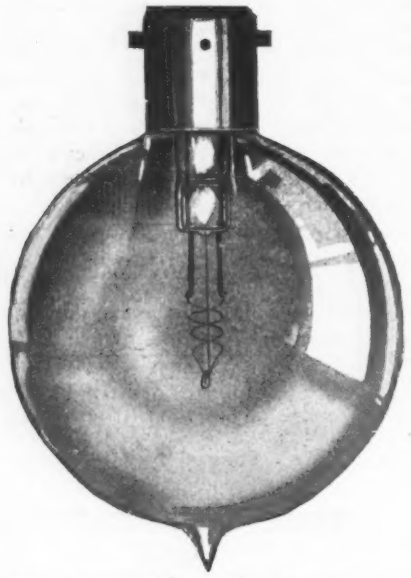


Fig. 1—Low-Voltage Tungsten Lamp.

Of the full line of 6-volt Edison "Mazda" lamps now available for this class of service the new upset-filament headlight lamp is the latest development. In this the closely coiled filament of drawn-wire tungsten is placed in the center of the bulb, the axis of the coil coinciding with a line drawn through the center of the lamp base to the tip of the bulb. This arrangement facilitates the adjustment of the lamp in the focus of the parabolic reflector, thereby greatly increasing the amount of useful light projected on the roadway. A 15-cp headlight of this type will illuminate the road to a distance of 2000 ft. ahead of the car. This lamp is made in 15-watt, 18-watt, 21-watt and 24-watt sizes, with bulbs 2 1/16 in. in diameter fitted with Edi-Swan candelabra bases, the light values ranging from 15 cp to 24½ cp. Edison "Mazda" lamps of the train-lighting type are available for electric-vehicle lighting service in 15-watt and 25-watt sizes for 25 volts to 90 volts supply.

For general lighting service the new lamps are made in all standard sizes from 25 watts to 500 watts, with either pear-shaped or round bulbs. The 400-watt and 500-watt units are to meet the demand for large lighting units where it has been necessary heretofore to use clusters of lamps or where arc lamps are inapplicable. They are particularly advantageous in the lighting of auditoriums, armories, warehouses, mills, factories and other large manufacturing establishments where it is necessary to locate the lamps at a considerable height above the working plane.

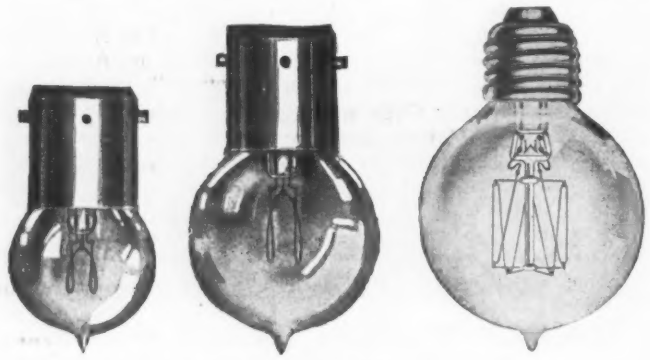


Fig. 2—Low-Voltage Tungsten Lamps.

HIGH-TENSION TRANSFORMERS.

The Pittsburgh Transformer Company through its sales agent, the Republic Electric Company, of Chicago, Ill., has placed on the market a line of weatherproof high-tension transformers in all voltages up to 33,000 for use on both 25-cycle and 60-cycle circuits. Operators of high-tension transmission systems are rapidly beginning to realize the possibility of selling power to farms, mills, mines and small communities located within a reasonable distance of the lines, but as the volume of business will not, as a rule, justify the installation and maintenance of substations, the present type of transformer has been developed to meet this condition.

As is well known, high-tension systems are subjected to excessive strains due to lightning, surges and static disturbances, and in order to operate successfully under these conditions transformers must have a very high factor of insulation. In these weatherproof high-tension transformers the coils are so connected that minimum potential stress is developed between turns or layers of the winding, and, in addition, the coils are given a final vacuum and impregnating treatment which not only renders them impervious to moisture, but also materially adds to the insulation strength.

High-Tension Transformer.

As an additional safeguard the incoming and outgoing leads have been brought through extremely heavy corrugated porcelain tubes set at an angle to the case, thus maintaining a permanently high factor of insulation between the leads and the ground. As this type of transformer corresponds in a sense to central-station apparatus, the manufacturers state that care has been taken to secure close regulation under all conditions of both single and polyphase operation, and owing to the interconnected system of coils the effects of low power-factors on regulation are kept at a minimum, thus insuring satisfactory service under a wide range of conditions. With these transformers central stations will be able to take on rural customers at a profit—something which could not be accomplished with the older type of transformers, requiring the construction and maintenance of substations.

Industrial and Commercial News

THE WEEK IN TRADE.

WHILE the attitude toward entering into new business on a large scale has become more conservative in the past week, approach of the fall season has assisted expansion of trade in parts of the country. Temporary removal of tariff uncertainties has caused a more cheerful feeling in many lines. Lower prices for cotton prints have attracted buyers, and the operations in the jobbing trade have been enlarged by good demand from retail interests. Demand for cotton goods as a whole is somewhat irregular, but the trade shows a gain over the business of recent weeks. The iron and steel trades are receiving a fair amount of orders, although the volume of new business shows a slight decrease. A number of bridge and rail orders of moderate size have been given in the past week, and increase is reported in the number of inquiries for rails and cars. Pig iron is not in active demand except in small lots for early delivery, and the total orders placed last week amounted to only 50,000 tons. There has been another small decrease in the number of idle cars. Among the causes of the immediate hesitation in general trade have been growth of labor troubles on several of the railroads and in several other industries. The demands of the shop employees of the Harriman lines were refused by the active head of the system, who stated that granting of the requests would mean chaos, and would narrow the ability of corporations to fulfil duties imposed upon them by law. Crop conditions are reported as encouraging and, as full harvest returns will probably be known before opening of the next session of Congress, it is expected that business will be greatly stimulated and in a position by that time to meet further tariff and investigating agitation. Business failures for the week ended August 24, as reported by *Bradstreet's*, were 198, as compared with 215 for the previous week, 235 for the corresponding week in 1910, 236 in 1908 and 167 in 1907.

THE COPPER MARKET.

LOWER prices, resulting from freer offerings of lake and electrolytic, were the only features of interest of the copper market in the past week. Reductions of ⅛ cent by the largest producer caused further shading by the independents. The London market was lower, and declines of 5s were made in standard spot and best selected. Buying, in spite of price concessions, was very light, both here and abroad. Domestic consumers purchased in small quantities for September and October delivery, with most of the sales of electrolytic on a basis of 12.40 cents to 12½ cents. It is rumored in the trade that many of the largest agencies are sold ahead for sixty days and that there are several others which have no copper available for early delivery. Although the domestic consumers are not buying heavily, the tone of the market at present is steady, and the expectation still holds that the August report of the Copper Producers' Association will show a reduction of some 5,000,000 lb. in domestic stocks. This estimate is based, first, on the demand from abroad, which in spite of irregularity, averages almost half of the total call on the refineries in this country, and secondly, upon the fact that deliveries during the month to domestic users have been nearly equal to those in the corresponding period in July. Total deliveries are expected to be close to 125,000,000 lb. There are few signs at present of early improvement either in the buying or in the prices of copper. The belief is still held that stocks in consuming hands are low and that supplies must be purchased for fall requirements, but the hesitation in general trade is exerting a marked influence upon copper users, so that such purchases as may be made will probably be on the present hand-to-mouth scale. Exports for the month, including August 29, were 24,148 tons. The daily call on the Metal Exchange, August 29, quoted copper as per the accompanying table.

Standard Copper.	Bid	Asked	Settling Price
Spot	12.05	12.20	.....
August	12.05	12.20	12.12½
September	12.05	12.20	12.12½
October	12.05	12.20	12.12½
November	12.05	12.20	12.12½

The London market, August 29, was as follows:

	Noon. £	s	d	Closing. £	s	d
Standard copper, spot	56	3	9	56	3	9
Standard copper, futures	56	16	3	56	16	3

Extreme fluctuations for this year:

	Highest.			Lowest.		
Standard	12.35			11.57½		
London, spot	57	10	0	53	7	6
London, futures	58	2	6	54	0	0
Best selected	61	10	0	57	5	0

INDUSTRIAL AND COMMERCIAL NOTES.

General Motors Truck Company to Make Commercial Electric Vehicles.—As recently announced in these columns, the General Motors Truck Company has formed an electric division under the management of J. M. Lansden to market a line of electric wagons and trucks. The company by this action states that it is in a position to advise impartially in the selection of a wagon or truck, whatever the service, as well as to sell complete equipments, including both gasoline and electric. The electric division will supply all types of electric chassis and wagons. The announcement states that it has no battery, tire nor electric affiliations, thus permitting the widest range in equipment and assuring that each installation shall fit the service for which it is intended. Every branch of the great organization of the General Motors Company is available for purchasing, production and distribution. The design will be dictated by Mr. Lansden's ten years' experience in the manufacture, operation and maintenance of hundreds of wagons, as well as by the analysis of widely varying requirements to give in general service cheap, but continuous, operation. Eight chassis, varying in load capacity from 1000 lb. to 6 tons, will be built in different lengths of frame and wheel base to give in every instance the proper design for the various styles and sizes of bodies necessitated by service. There will also be established a completely equipped service department with its head at Detroit and branches in various large cities, and there will be a corps of commercial engineers available at all times in connection with the selection, installation or operation of motor wagons.

To Import Plania Carbons.—H. M. Hirschberg, president of the Excello Arc Lamp Company, has made arrangements for the exclusive importation of Plania carbons for New York and Canada. These carbons are the product of the Plania works at Ratibor, Silesia, which employs over 1800 hands and is said to be the largest European plant of its kind, and the only company manufacturing large carbon electrodes for refining and electric smelting purposes. In addition to this product, the company manufactures carbons for all types of flaming, inclosed, open and miniature arc lamps. The New York representatives will carry a large stock of arc-lamp carbons in order to meet the requirements of both domestic and export business. Mr. Hirschberg says that August business in flaming-arc lamps was better than in August last, and that the outlook in this line is exceptionally bright.

General Electric Orders.—The Des Moines City Railway Company, Des Moines, Iowa, has placed an order with the General Electric Company for a 2000-kw, 25-cycle, mixed-pressure turbine, and a 75-kw turbo-exciter. The turbine will take steam from two engines driving 1000-kw, direct-current generators. The Pacific Mills, Lawrence, Mass., have ordered a 1000-kw, three-phase, 50-cycle, 600-volt horizontal Curtis turbine. Over 11,000 hp of General Electric motors are now installed in these mills.

Progress of Tallulah Falls Hydroelectric Development.—Work is progressing rapidly on the hydroelectric development of the Georgia Power Company at Tallulah Falls, where it is planned to generate some 60,000 hp. Contracts have been let for the construction of the dam and tunnel, and the 100,000-volt transmission line is now being constructed. It was stated this week at the office of C. O. Lenz, chief engineer of the Northern Contracting Company, which is doing the construction work, that the system will be completed by December, 1912.

Westinghouse Orders.—Among recent orders received by the Westinghouse Electric & Manufacturing Company are the following: From the Minneapolis General Electric Company, of Minneapolis, Minn., for three 1000-kva, oil-insulated, water-cooled, 13,200-volt transformers; the Great Shoshone & Twin Falls Water Power Company, of Twin Falls, Idaho, for five 75-kva, 24,000-volt, oil-insulated, self-cooled transformers; the Pacific Gas & Electric Company, of San Francisco, Cal., for ten 1000-kva, oil-insulated, self-cooled, tubular type, 11,000-volt transformers; from the Cincinnati Traction Company, for an equipment for generating station and three substations, consisting of one 6000-kva, 25-cycle, 13,200/6600-volt, three-phase turbo-generator, with direct-connected exciter; five 1500-kw, 25-cycle, six-phase, 600-volt, rotary converters, self-starting from alternating end; sixteen 500-kva, 25-cycle, 13,200/6600-volt, oil-insulated, self-cooled transformers; four switchboards for control of the above apparatus; from the Groton & Stonington Street Railway Company, of Mystic, Conn., for three quadruple, direct-current motors with controllers; the Connecticut Valley Street Railway Company, of Gainesville, Mass., for five quadruple, direct-current motors and controller; the Indianapolis Traction & Terminal Company, for two direct-current motors; the Savannah Electric Company, for three double-equipment, interpole railway motors with controller. The Boston Elevated Railway Company has placed an order for fifty quadruple equipments of No. 306 interpole motors with type HL control, for use on the Cambridge division.

Winnipeg Traction Conference.—Messrs. Mackenzie and Mann have had another conference with the special committee of the City Council of Winnipeg regarding purchase by the city of the Winnipeg Electric Railway Company for $24,000,000. The points at issue are agreement on a basis of audit and whether the Mackenzie-Mann interests will include the suburban lines in the sale, which at present they do not wish to do. The city wishes to acquire these as well as the other properties in question, and will not purchase unless they are included. Mackenzie and Mann, it is stated, want the city, prior to the audit, to bind itself to submit a by-law of purchase to the people in case experts show that the stock of the company is paying 5 per cent on a valuation of $250 per share; but the city has been holding out for a 7 per cent dividend on the valuation. After the meeting Mayor Evans said in part: "Very satisfactory progress was made at to-day's conference. It seems probable that an understanding can be reached on all the main features of a proposition which the committee thinks it will be justified in presenting to the people for their vote. One or two matters have yet to be considered, but the prospects of an understanding are favorable." It is understood that no definite agreement was reached on the inclusion of the suburban lines, but the special committee of the City Council made it plain that this point will have to be conceded by the Mackenzie-Mann interests, and that no basis of audit other than 7 per cent will be considered.

Progress of Northern Ohio Traction Plans.—The Northern Ohio Power Company, which is building a combined steam and hydroelectric plant at Cuyahoga Falls for supplying energy to the Northern Ohio Traction & Light Company, is purchasing land for a right-of-way for its transmission lines from the new station, across to the old hydraulic canal and along this canal to the Beech Street station of the railway company in Akron. It is proposed to convert this station into a substation and distribute energy for light and power from it to all parts of the city. The Northern Ohio Traction & Light Company has planned a high-level track along nearly the same route, across the Cuyahoga Valley at Akron on a long bridge. At present the road follows the lay of the land at that point and has a steep hill to climb on each side. It is planned to improve this condition and others, and while these improvements may not be made for some time preparations are being made in readiness for them, as well as for a new terminal at the old Webster, Camp & Lane shops, which have been purchased for that purpose. A new depot will be established there for all the interurban lines entering Akron.

Valuation of Electric Properties.—The value of electric railways in the State of Washington, as given by the report of the Washington Tax Commission, is $30,449,708, and the highest valuation is for the Seattle Electric Company, which is placed at $14,437,987. The Washington Water Power Company is valued at $3,611,526, the Tacoma Railway & Power Company at $3,580,323, and the Seattle-Everett Traction Company at $1,331,420. The lowest on the list is the Loyal Railway Company, of Ballard, Wash. A similar list compiled by the State Tax Commission of Wisconsin estimates the value of electric railways in the State at $37,2900,000. The list is headed by the Milwaukee Electric Railway & Light Company, which is valued at $24,000,000. The Milwaukee Light, Heat & Traction Company is placed at $6,650,000, and the Eastern Wisconsin Railway & Light Company at $775,000. The lowest valuation is that of the La Crosse & Onalaska Street Railway Company, which is controlled by the La Crosse City Railway Company.

Aluminum Notes and Prices.—The aluminum market as of August 29 is reported steady, with ingots for remelting held at 20@22 cents spot No. 1, the base for large ingots. Sheets are quoted at 33 cents, and rods and wire at 31 cents. A recent summary of the aluminum industry, compiled abroad, states that the trade is now in the hands of only twelve companies, and that nine-tenths of the entire output is accounted for by the following companies: Aluminum Industrie Akt. Ges., of Neuhausen; the Société Electro-Metallurgical Française, of Froges; the Compagnie des Produits Chimiques d'Alais et de la Camangue, of Salindres; the British Aluminum Company, Limited, and the Aluminum Company of America. The European price of aluminum as quoted in London has recently been £60 to £61 per long ton, equivalent to 13 to 13¼ cents per pound. The American tariff is 7 cents per pound.

Says Texas Has No Electrical Trust.—A. P. Lightfoot, Attorney-General of the State of Texas, has reported to the Legislature his findings in the investigation of an alleged electrical trust in Texas. Mr. Lightfoot reports that he has made an investigation of combinations of electrical concerns, the work taking him to New York, Boston and other Northern cities, and says that he has found no violations of the anti-trust law. He states that there seems to be merely a community of interests. Mr. Lightfoot will continue his investigations in this direction and make another report later on.

Electrical Construction.—Among the items printed under Construction News in the current issue are announcements of proposed new plants or considerable extensions to present plants at Red Cloud, Minn.; Pocahontas, Ia.; Nelsonville, Ohio; Husum, Wash.; Los Angeles, Cal.; Sumas, Wash.; Olympia, Wash.; Tombstone, Ariz.; Johnstown, Pa.; Lima, Ohio; Rutherfordton, N. C.; Dorris, Cal.; White Lake, S. D.; Burns, Ore.; Owensboro, Ky.; Lexington, Tenn.; Tampa, Fla.; Baraga, Mich.; Port Stanley, Ont., Can.; Ness City, Kan.; Altoona, Pa.; Muscoda, Wis., and Missoula, Mont.

General Electric Business.—Estimates place current business of the General Electric Company at about 94 per cent of the largest in the history of the company. At this rate gross business for the year should be close to $67,000,000, as compared with $71,500,000 for 1910, and with these returns there will be a large surplus in excess of dividend requirements. Reports of an increase in dividends following settlement of the government controversy have been in evidence from time to time, but it is stated that the management has not discussed the matter.

Another Aqueduct Contract.—The New York Edison Company has closed a contract with the Mason & Hanger Company for supplying 2000 hp for operating the construction plant on its section of the Catskill Aqueduct. This extends from a point some 200 feet north of the Yonkers city line to University Heights in the Bronx. The closing of this contract, the fourth which the New York Edison Company has on this work, completes arrangements for the use of electricity for all construction work on the Aqueduct.

Toledo Railways & Light Company.—The City Solicitor of Toledo, Ohio, has filed a suit to prevent the Toledo Railways & Light Company from using sections of eighteen streets over which cars are now being operated although franchises have expired. It is stated that the city is seeking a permanent injunction. Failure on the part of the company to pay a rental at $250 per day for each of these streets on which franchises have expired is the cause of the suit. About $70,000 rental is now due.

Catalogues and Price Lists Wanted.—Kaloust Kouyoumjian, Bagdad, Asiatic Turkey, who is commercially interested in electricity, would be glad to receive catalogues, prices, etc., from American electrical manufacturers. Correspondence may be in English.

Financial.

THE WEEK IN WALL STREET.

BEARISH operations dominated the market last week, and at its close the entire list of active stocks, excepting Atchison, dropped to the lowest levels thus far in 1911. Evidence of the professional nature of the market was furnished by Monday's transactions, these showing a decrease in selling pressure and an increase in the resistance offered to the pressure that remained. Many of the stocks that had declined in the latter part of the previous week made some recovery during the day, and the advancement took place under the lead of Union Pacific and United States Steel, the two issues that figured prominently in the decline. News of direct bearing upon the financial situation was concerned chiefly with the labor troubles on Western railroads, and with the effect of the recent decline as an influence upon European markets. Prices on Tuesday were steady until near the close, when pressure was applied to a number of stocks, forcing them downward again, but with few important changes. Fresh rumors of a federal suit against the Steel Corporation assisted in bringing down the prices of its shares, and the labor conditions on the Harriman roads were a matter of discussion in the market. Although many speculators had forecast the government's monthly report on the cotton crop, due on Friday of this week, the Street was awaiting it with interest. It was believed that deterioration would not be in excess of the usual August amount and, even if this were the case, that the crop would be the largest on record. The money market is quiet at present, but will probably reflect within a short time the efforts of outside banks to finance the requirements of the harvests. Rates Aug. 29 were: Call, 2¼@2½ per cent; ninety days, 3@3¼ per cent. The quotations in the tables are those at the close Aug. 29.

NEW YORK.

	Aug. 22.	Aug. 29.	Shares sold.		Aug. 22.	Aug. 29.	Shares sold.
All. Ch.	6½*	6½*	100	Int. Met., pf.	42½	43½	3,030
All. Ch., pf.	20*	18*	400	Mackay Cos.	83⅛	83½*	100
Amal. Cop.	61	58	78,250	Mackay C., pf.	72*	72*	———
Am. D. T.	20½*	20½*	———	Man. Elev.	135*	135	300
Am. Loco.	36¼	34⅞	3,400	Met. St. Ry.	15*	15*	———
Am. Loco., pf.	107*	104¾*	425	N.Y.&N.J.Tel.	139½*	139½*	———
Am. Tel. & C.	79¾*	79¾*	———	Steel, com.	72⅞	69¾	850,340
Am. T. & T.	133¾	131⅞	8,020	Steel, pfd.	115¾	114½	9,900
B. R. T.	75¾	75¼	7,200	W. U. T.	75	74	4,801
Gen. Elec.	153	151¾	2,800	West'h, com.	66	64¼*	3,600
Int. Met.	15⅜	14½	9,400	West'h, pfd.	112	114*	700

PHILADELPHIA.

	Aug. 22	Aug. 29		Aug. 22	Aug. 29
Am. Rys.	45	44½	Phila. R. T.	23	22¾
El. Co. of A.	11⅞	11¾*	Phila. Elec.	17⅛	17⅛
Elec. St. Bt'y	52¾	52¼	Phila. Trac.	86*	84½
Elec. St. Bt'y., pf.	30*	30*	Union Trac.	50¾	50½

CHICAGO.

	Aug. 22	Aug. 29		Aug. 22	Aug. 29
Chi. City Ry.	186*	186*	Com. Edison	133	132⅛
Chi. Elev. Rys.	25	25*	Chi. Subways	2⅞	2¾*
Chi. Elev. Rys., pf.	90	90*	Chi. Tel. Co.	123*	120½
Chi. Rs., Ser. 1.	95*	95*	Nat'l Car,	101*	100*
Chi. Rs., Ser. 2.	29¾*	27¼	Nat'l Car, pf.	118½*	118½*

BOSTON.

	Aug. 22	Aug. 29		Aug. 22	Aug. 29
Am. T. & T.	133⅞	131⅞	Mex. Tel.	4¼*	4¼*
Cum. Tel.	156*	156*	Mex. Tel. pf.	6*	6*
Edison E., Il.	286½*	286	N. E. Tel.	146½	145
Gen. Elec.	153½	151	W. T. & T.	18¼*	18¼*
Mass. E. Ry.	18¼*	17¼	W. T. & T., pf.	98	98*
Mass. E. Ry., pf.	88½*	88*			

*Last price quoted.
Shares sold for the week, Aug. 21 to Aug. 26.

FINANCIAL NOTES.

Mexican Tramways Company.—During the past six fiscal periods earnings of the Mexican Tramways Company have shown annual increases, the highest total having been made in 1910, as regards both gross and net income. In the last fiscal period the company carried more than 76,000,000 passengers, as against not quite 72,000,000 in the year previous. The gross income and net income have almost doubled during the last six years, being $5,882,534 and $2,996,610, respectively, in 1910, as against $3,642,106 and $1,465,732, respectively, in 1905. Average daily earnings from operation during the last fiscal year were also the largest on record, while the average daily expenses were likewise the highest. In 1910 the average daily earnings from operation amounted to $15,986 and the average daily expenses were $7,626, compared with daily earnings of $14,748 last year and daily expenses of $7,183, and with average daily earnings of $9,482 and daily expenses of $5,740 in 1905, six years ago. A noteworthy feature of the exhibit for the last fiscal period, however, was the reduction of about one point in the operating ratio as compared with the year previous, the ratio being 49.06 in 1910 and 50.02 the year previous. This ratio is the lowest reported since the company was organized, indicating that efficiency of operation has been materially increased from year to year. The ratio in 1905 was 59.75. The total amount of equipment on hand, representing motor cars, mule cars, railway engines, etc., was 633, as compared with 652 in 1909 and 569 in 1905. Further details of the record for the fiscal year ended June 30 were given in these columns August 5.

Great Western Power Company.—At the recent meeting of directors of the Great Western Power Company held in San Francisco to effect the change in control resulting from purchase of the City Electric Company, Herbert and Mortimer Fleishacker were elected vice-presidents, and the latter was given the management. Edwin Hawley remains as president and H. P. Wilson as secretary. Mr. Wilson has called a meeting of stockholders of the Great Western Power Company and the California Electric Generating Company for October 26, in San Francisco, for considering an increase in the capitalization of the parent company from $25,000,000 to $27,500,000. A plan to make dividends on the stock of the subsidiary company cumulative after January, 1912, will be presented to the stockholders, and there will be discussion of the advisability of entering into a contract for energy with the City Electric Company. The question of guaranty by the California Electric Generating Company of payment of interest upon $1,700,000 bonds of the City Electric Company will be considered.

Status of Westinghouse Business.—The electric fan business of the Westinghouse Electric & Manufacturing Company this summer is stated to be the largest in the history of the company. Orders called for more than 100,000 fans, and the department was operated at full capacity throughout the summer. Business in other departments is irregular, demand for general supplies being good, but in some other branches a falling off in orders is reported. The entire business of the company at present is regarded as between 75 per cent and 80 per cent of full capacity. One of the large items of expense now borne by the company is due to development of new patents for increasing still further the efficiency of its apparatus. In spite of agitation for dividends on assenting stock there is not likely to be a disbursement in this direction until the management feels that the financial status of the company is extremely sound.

Hudson River Power Companies Sold.—At a foreclosure sale held August 29 at Ballston Spa, N. Y., the franchises and properties of the Hudson River Electric Power Company and subsidiaries were sold to representatives of the bondholders' committee for $7,500,000. This was $3,000,000 more than the upset price fixed by the courts, and resulted from active bidding between the representative of the bondholders and Anthony N. Brady, who is interested in several public utilities in the upper part of the State. The sale includes the properties of the following companies: Hudson River Water Power Company, Hudson River Electric Company, Hudson River Transmission Company, Ballston Spa Light Company, Saratoga Gas, Electric Light & Power Company, the Empire State Power Company, and the Madison County Gas & Electric Company.

Commonwealth Edison May Buy Chicago & Milwaukee Electric.—There are rumors that the Commonwealth Edison Company will bid in the Chicago & Milwaukee Electric Railroad Company at an early foreclosure sale. The road is now in the hands of receivers, and a decree by Federal Judge Grosscup ordering its sale is thought to be forthcoming. In accordance with the terms of the elevated consolidation cars of the Chicago & Milwaukee will enter the city over the tracks of the Northwestern Elevated.

Combination of Southern Lighting Companies.—Chicago capitalists, it is stated, are negotiating for the stock of the Louisville Gas Company, which controls the Louisville Lighting Company, and it is believed that they will endeavor to secure control of the Kentucky Electric Company, with a view of effecting a combine of companies operating in the section.

Oregon Company Changes Hands.—The properties of the Rogue River Electric Company, of Medford, Oregon, have been purchased by the Siskiyou Electric Light & Power Company, of Yreka, Cal., this transaction giving the purchaser control of water resources in Southern Oregon and Northern California.

Pacific Gas & Electric Extension.—D. H. Foote, secretary of the Pacific Gas & Electric Company, of San Francisco, has announced that the stockholders of the company will be called upon to vote at a special meeting Oct. 23 on an increase of the bonded indebtedness of the company to $150,000,000, with a parallel increase in the capitalization to $160,000,000, all of the proposed increase to be common stock. About $60,000,000 of the bonds will be used for refunding the company's present issues, the balance being available for development work during the next ten years. The recently announced plans of the company for extensive power development in Northern California have attracted attention to its growth in business and revenues during the few years past. The company operates, at present, eleven hydraulic plants with a total generating capacity of approximately 93,000 hp, three steam plants rated at 96,000 hp, and has about 1000 miles of transmission lines. It serves with electricity a population of close to 1,100,000 in 158 towns and cities in twenty-six of California's fifty-six counties, a total area of about 32,500 square miles. Plans for development include new hydraulic plants to augment the generating capacity by 71,000 hp, giving a total of 260,000 hp as the gross output of the company. New transmission lines are to be constructed, and additional territory is to be tied in with the system, there being a steady increasing demand to utilize the product throughout the northern section of the State. The work planned is estimated to cost $10,000,000. Dating from 1906, the gross revenues of the company have expanded to the extent of over $1,000,000 per annum. A financial statement for the past five fiscal years follows:

	Gross Revenue.	Net Revenue.	Surplus.
1906	$8,947,162	$4,524,043	$557,687
1907	11,342,140	5,115,911	1,082,789
1908	12,715,746	5,806,145	1,519,101
1909	13,650,075	5,800,925	1,502,957
1910	14,229,228	5,938,623	1,551,844

Electric Bond & Share Company.—The directors of the Electric Bond & Share Company are submitting to the preferred stockholders for their approval a plan to increase the authorized capital stock of the company from $2,000,000 common and $2,000,000 preferred stock to $5,000,000 of each issue, necessity for this increase in capitalization arising from expansion of business. The plan provides, among other things, that the preferred stockholders will later receive, share for share, 6 per cent preferred stock in exchange for the 5 per cent stock deposited. It is also proposed to make certain changes in the certificate of incorporation and by-laws of the company, designed to remove unusual restrictions which, in the opinion of the board of directors, have been shown by experience to be cumbersome and detrimental to the best interests of the company. The common stockholders have assented to the plan and have agreed to purchase $1,500,000 of new common stock at par. The remainder of the stock will be sold from time to time to meet the capital requirements of the company, subject to the provisions of the company's charter that the preferred stock outstanding at no time shall exceed the oustanding common stock. Owners of the preferred stock are now asked, in order that the plan may be carried out, to deposit their stock certificates either with the Standard Trust Company of New York or the Old Colony Trust Company of Boston. Transferable receipts will be issued in exchange for the stock certificates. The Electric Bond & Share Company was incorporated Feb. 28, 1905. Since that date it has been engaged in financing electrical enterprises and has been instrumental in distributing to investors a large amount of public utility securities. The company has paid dividends at the rate of 5 per cent on its preferred stock since organization. The present rate on the common stock is 8 per cent. The company's surplus and undivided profits amounted to $1,286,627, as of Dec. 31, 1910.

Earnings of Detroit Edison Company.—Gross earnings of the Detroit Edison Company for July were $231,396, an increase of $25,475 over the revenue in the same month in 1910. Operating expenses were $144,362, an increase of $17,975, and net income was $87,034, which was $7,500 larger than last year's figure. Interest charges were $50,716, an increase of $5,317, and surplus for the month was $36,318, being $2,183 over the surplus in the corresponding month of the previous year. In the seven months ended July 31 gross earnings were $1,868,587, as compared with $1,563,153 last year. Operating expenses were $1,102,594, as compared with $903,820, and net income was $765,993, which shows an increase of $106,660. Interest charges for the seven months were $337,081, as compared with $302,800, and the surplus was $482,912, against $356,533 in the same period in 1910. Estimates based upon the present scale of earnings place the surplus available for dividends at the end of the year at 15 per cent on the $5,747,000 stock outstanding, as compared with 12.33 per cent for last year.

United Railways of St. Louis.—Gross earnings of the United Railways Company of St. Louis for July were $1,016,759, an increase of $28,679 over the returns for the same month in the previous year. Total expenses and taxes were $686,838, an increase of $24,022, and net income was $333,210, which was $3,996 larger than in 1910. Interest on bonds was $228,312, a decrease of $4,690, and the balance available for dividends was $104,898, representing an increase in this item of $8,686. In the seven months ended July 31 gross earnings were $6,841,998 an increase of $251,854, and net income was $2,145,181, which represents an increase of $128,598 for the period as compared with 1910. The balance available for dividends was $539,620, an increase of $155,355. From present indications the company will have a surplus available for dividends at the close of the year more than sufficient to meet the 5 per cent on the preferred stock outstanding.

Rome (Ga.) Railway & Light Company Bonds.—First mortgage 5 per cent gold bonds of the Rome (Ga.) Railway & Light Company are being offered by a New York banking house. The bonds are dated January 1, 1907, are due January 1, 1937, and are subject to redemption in whole or in part at 105 and accrued interest on any interest date on six months' notice. Earnings in the past few years have been over twice interest requirements on these bonds, and from the record for the first six months in the present year it is expected that more than three times the requirements will be earned.

Southern Bell Telephone Company to Issue Bonds.—The Southern Bell Telephone Company has filed a deed of trust covering an authorization of a $50,000,000 bond issue in Fulton County, Georgia. The Bankers' Trust Company and John H. Parsons, of New York, are named as trustees, and ten millions have been issued to date. It is stated that a copy of the deed will be filed in every county where property is owned by the corporation.

Cuyahoga Telephone Meeting.—Retiring officers were re-elected at the meeting of directors of the Cuyahoga Telephone Company. Other business transacted at the meeting was said to be merely of routine nature.

DIVIDENDS.

Muskogee (Okla.) Gas & Electric Company, quarterly, preferred, 1¾ per cent, payable Sept. 15.

Oklahoma Gas & Electric Company, quarterly, 2 per cent, payable Sept. 15.

San Diego Consolidated Gas & Electric Company, quarterly, 1¾ per cent, payable Sept. 15.

West Penn Traction Company, quarterly, 1 per cent, payable Sept. 15.

REPORTS OF EARNINGS.

AMERICAN LIGHT & TRACTION COMPANY.

Period.	Gross Earnings.	Operating Expenses.	Net Earnings.	Fixed Charges.	Net Surplus.
July, 1911	$284,892	$9,537	$275,255	.....	.....
July, 1910	250,723	10,669	240,054	.....	.....

CUMBERLAND TELEPHONE & TELEGRAPH COMPANY.

July, 1911	$611,108	$368,366	$242,741	$50,681	$192,060
July, 1910	565,555	321,582	243,973	48,802	195,171

MONTREAL STREET RAILWAY COMPANY.

July, 1911	$437,771	$231,068	$206,703	$72,088	$134,615
July, 1910	398,847	215,224	183,623	58,459	125,163

NASHVILLE RAILWAY & LIGHT COMPANY.

July, 1911	$154,671	$93,961	$60,710	$38,520	$22,190
July, 1910	144,548	84,134	60,414	37,708	22,706

NEW ORLEANS RAILWAY & LIGHT COMPANY.

6 m., June, 1911	$3,337,433	$2,036,467	$1,307,966	$881,466	$426,450
6 m., June, 1910	3,142,295	1,928,712	1,213,712	876,701	348,248

NORFOLK & PORTSMOUTH TRACTION COMPANY.

Yr., June, 1911	$2,091,616	$1,212,404	$879,212	$743,579	$135,632
Yr., June, 1910	1,920,841	1,110,489	810,351	777,216	33,135

NORTHERN OHIO TRACTION COMPANY.

July, 1911	$278,431	$141,003	$137,428	$44,321	$93,107
July, 1910	262,020	131,937	130,082	43,357	86,725

PHILADELPHIA RAPID TRANSIT COMPANY.

July, 1911	$1,856,815	$1,144,766	$712,048	$737,289	*$25,240
July, 1910	1,771,954	1,082,201	689,752	734,241	*44,488

TWIN CITY RAPID TRANSIT COMPANY.

July, 1911	$710,067	$337,555	$372,512	$140,079	$232,433
July, 1910	682,611	318,594	364,018	140,113	223,905

*Deficit.

General News

Construction News.

BIRMINGHAM, ALA.—The Birmingham, Ensley & Bessemer Railroad Company, it is reported, is planning to erect a power plant .

EUFAULA, ALA.—At an election held Aug. 22 the proposition to issue bonds to the amount of $40,000, the proceeds to be used for the installation of a municipal electric-light plant, was carried.

HAYDEN, ARIZ.—The Ray Consolidated Copper Company contemplates the installation of electric pumping machinery for irrigation work.

PHOENIX, ARIZ.—The Salt River Valley Electric Company, recently organized, has applied for a twenty-five-year electric railway franchise in this city. F. M. Winter is interested in the company.

PHOENIX, ARIZ.—It is reported that an extensive system of electric railways is to be constructed through the Salt River Valley with Phoenix as the radiating center. As a first step in this direction Epes Randolph, vice-president of the Arizona Eastern and the Southern Pacific Railroad of Mexico, both Southern Pacific properties, recently acquired control of the street-railway system here. Surveys for proposed extensions to various points in the valley are being made.

TOMBSTONE, ARIZ.—The Western Mines & Development Company (Towner-Lovell mines) is contemplating the installation of an electric-power plant.

HARRISON, ARK.—W. H. Standish is reported to have secured permission from the federal government to erect a hydroelectric power plant on the White River, 10 miles below Fordyce. The work will include the construction of a tunnel, 3000 ft. long, dam and power house. It is estimated that several hundred hp can be developed.

ALAMEDA, CAL.—The City Council has adopted a resolution ordering ornamental lamp posts set in concrete base to be erected on certain streets in the city of Alameda.

BAKERSFIELD, CAL.—In its budget for the fiscal year commencing October, 1911, the Kern River Oil Fields, Limited, will make an appropriation for motors for oil-drilling operation.

BAKERSFIELD, CAL.—The Board of Trustees has refused payment of its regularly monthly account for arc lamps to the San Joaquin Light & Power Company on the grounds that the company had made a reduction of 25 per cent in rates to private consumers and did not grant same to the city. If the company does not make a reduction in the rate the present contract will be canceled and the rates fixed by the board.

COLTON, CAL.—The Southern California Edison Company has awarded the contract for the erection of a substation at Colton to the F. O. Engstrom Company, of Los Angeles, to cost approximately $16,000.

CORONA, CAL.—The plant and holdings of the Corona Gas & Electric Company are reported to have been purchased by the Southern Sierras Power Company.

COURTLAND, CAL.—The New Freeport Telephone & Telegraph Company has awarded the contract for the erection of a new building to Hendren & Guth.

DORRIS, CAL.—Surveys have been completed for the proposed transmission line of the Siskiyou Electric Light & Power Company, of Yreka, Cal., from Ashland, Ore., to Dorris. Work will soon begin on the erection of the proposed line. Dorris will be the distributing station for Macdoel and two large ranches of Yreka. Contracts for material have already been placed.

FRESNO, CAL.—The Pacific Light & Power Corporation, of Los Angeles, Cal., has filed articles of incorporation with a capital stock of $40,000,000, to enable it to operate in this section. William G. Kerckhoff, Charles Forman, Howard Huntington and H. E. Huntington are directors.

FULLERTON, CAL.—The Southern California Edison Company has submitted a proposition to the Council offering to install and maintain a new street-lighting system consisting of five 500-watt and five 250-watt tungstens in the business district and forty-five 50-watt tungstens in residential section, at the rate of $98.75 a month. The offer, it is said, will be accepted.

LOS ANGELES, CAL.—The Los Angeles Railway has filed application for a franchise for an electric railway from Boyle Heights to a point near Eastlake Park.

LOS ANGELES, CAL.—The Pacific Telephone & Telegraph Company has awarded the contract for erection of a three-story exchange building on Vernon Avenue to Carl Leonhardt, of Los Angeles, to cost $30,000.

LOS ANGELES, CAL.—A power and generating plant will be installed in the new thirteen-story office building to be erected on Broadway by the Los Angeles Investment Company. The cost of building is estimated at $1,000,000.

LOS ANGELES, CAL.—The Union Oil Company has awarded the contract for the installation of a power and generating plant in its new thirteen-story office building on Spring Street to the John W. Catron Company, of Los Angeles, for $11,325.

LOS ANGELES, CAL.—To encourage the installation of ornamental lamps, the City Council has adopted a policy of paying the same price toward such as the lamp service in the district is costing. Heretofore the city has paid one-eighth, the property owners bearing the balance.

LOS ANGELES, CAL.—The new ordinance adopted by the Council recently went into effect Aug. 12. The ordinance does not contain the proposed 35-cent meter charge, but provides that the minimum monthly charge shall be 75 cents and establishes a 7-cent rate for electricity for lamps.

LOS ANGELES, CAL.—The city of Los Angeles has filed on additional power sites on the Owens River and Cottonwood Creek, on the route of the aqueduct, increasing the estimated capacity of the power plants to be installed from 120,000 to 150,000 hp. The Power Bureau is preparing plans and specifications for the power plant to be erected in the San Francisco canyon, known as No. 1, to have a generating capacity of 30,000 hp., and will advertise for bids for machinery at once, to be opened in October. E. F. Scattergood is chief engineer.

LOS ANGELES, CAL.—The Power Bureau has recommended to the City Council of Los Angeles the establishment of a 12-cent rate for electricity for lamps in Independence, Lone Pine and other towns along the route of the Los Angeles aqueduct, and a meter charge of 25 cents per month, except where the consumer supplies the meter, with a minimum charge of $1 per month. Refusal of the City Council to definitely fix rates has led the Power Bureau to act upon its own initiative and establish the above schedule. Electricity is being supplied from the plants already installed for construction purposes, near the intake.

LOS ANGELES, CAL.—City Electrician R. H. Manahan has requested the Board of Public Works to give definite information as to the intentions of the city for street-lighting service when power from the proposed aqueduct plants is available. An addition of 360 arc lamps is provided for in the city budget, making a total of 3560 lamps then in service, at a price of $75.60 per lamp a year, from the Los Angeles Gas & Electric Company. An endeavor to establish lower rates has met with that company's refusal until it learns whether its system will be taken over by the city at just valuation, or whether an entirely new system is to be installed.

MADERA, CAL.—The San Joaquin Light & Power Company, it is reported, is planning to erect a transmission line from Madera to Los Banos. A branch line will extend from a point on the line between Dos Palos and the river to a point three miles west of Mendota, where a substation will be located. Another substation will be built at Los Banos. James Berryman, of Dos Palos, is in charge of the work.

PETALUMA, CAL.—The Petaluma Telephone Company is planning to erect a telephone line from Petaluma to Cotati.

REDDING, CAL.—The installation of the Coleman power plant and other operations in the four completed plants of the company are leading up to the harnessing of the greatest unit in its large system. The company is utilizing the waters of three Battle Creeks and their tributaries east of Redding and Anderson. The Coleman plant when completed will have an output of 21,000 hp, which with the Volta, Kilare, Inskip and south plants of the company will give an aggregate output of 51,000 hp.

RIVERSIDE, CAL.—The Home Telephone Company has applied for a franchise covering Riverside County.

ROSEVILLE, CAL.—The Board of Trustees has directed City Engineer Marshall and City Engineer Gibson to submit estimates at the next meeting on the proposition of the city purchasing an electric-light plant, for which bonds were voted some time ago.

SACRAMENTO, CAL.—The Retail Merchants' Association, it is said, is planning to install an ornamental street-lighting system in the business section of the city. It is proposed to erect electroliers. When completed the system will be taken over by the city.

SACRAMENTO, CAL.—The Pacific Gas & Electric Company is planning to make extensive improvements to the local street car system, which will involve an expenditure of about $1,000,0000. A permit has been obtained by the company for the reconstruction of its car barns, located at Twenty-eighth and M Streets, the cost of which is estimated at $45,000.

SACRAMENTO, CAL.—Work will begin immediately by the Citizens' Light & Power Company on the construction of the conduit which will run from Seventh and M to Seventh and I Streets. Steel conduits will be used. The poles in the residence district will be placed in alleys. Energy is delivered at the substation of the company located at Eighth and R Streets, where it is transformed for distribution throughout the city.

SAN DIEGO, CAL.—Plans are being considered to replace the open arc lamps on the west side of the city with the metallic flame-arc

to correspond with those being use on the east side. The proposed change will require some changes to the generators at the west side pumping station. The cost of the entire work is estimated at about $6,500.

SAN FRANCISCO, CAL.—The United Properties Company has completed surveys for an electric railway between this city and Sacramento, and will soon commence work on construction of same.

SAN FRANCISCO, CAL.—Bids will be received at the office of the Board of Public Works, 993 Market Street, San Francisco, Cal., until Sept. 20 for furnishing and installing laundry plant in the power house and laundry building at the San Francisco Building. Also for furnishing and installing steam turbines, generators and main switchboard, sterilizers and disinfectors, ice-making and refrigerating plant in the power house and laundry building at the San Francisco Hospital. Also for furnishing and installing steam, gas and water piping for tunnel in San Francisco Hospital, and for furnishing and installing plumbing, gas fitting and piping in power house and laundry building; for furnishing and installing boilers, boiler-room auxiliaries and piping in power house and laundry building. Plans and specifications are on file at the office of the clerk of the Board of Supervsors.

SAN JOSE, CAL.—The construction of an electric railway between San Jose and Almaden is contemplated by C. A. Nonas, president of the Almaden Quicksilver Mines.

SANTA ANA, CAL.—The Southern California Edison Company has brought suit in the United States Circuit Court at Los Angeles to restrain the city of Santa Ana from enforcing an electric-light ordinance with rate of 7 cents per kw-hour, from 250 to 8000 kw, and 1½ cents per kw-hour above 8000 kw, with minimum of 50 cents. The company claims that physical valuation will show the rates to be confiscatory.

STANTON, CAL.—The installation of electric-light and water-works systems in Stanton is reported to be under consideration.

VALLEJO, CAL.—John W. Danforth, 72 Ellicott Street, Buffalo, N. Y., has secured the contract for furnishing equipment for auxiliary plant at the navy yard, Mare Island, Cal., for $104,420, bids for which were opened July 8.

VENICE, CAL.—It is reported that it is proposed to erect a power plant in connection with the new Polytechnic High School.

VENTURA, CAL.—The power plant of the Union Oil Company, near here, was recently destroyed by fire.

COLORADO SPRINGS, COL.—The question of improving the street-lighting system and also erecting colored streamer lamps across the streets to be used for special occasions is under consideration by the Chamber of Commerce.

MERIDEN, CONN.—The Berlin Street Railway Company, organized to build an electric railway between Meriden and Berlin, with a branch line from Berlin to New Britain, is planning to begin work on construction of the proposed road at an early date. H. M. Kochersperger is president of the company and J. T. Kelly, of New Haven, Conn., secretary.

PLAINVILLE, CONN.—The Trumbull Electric Manufacturing Company is reported to have awarded the contract for installling equipment at its power plant to the Shaffer March Company, of Bristol, Conn.

WESTPORT, CONN.—The plant and holdings of the Westport Water Company have been purchased by the Housatonic Power Company, of New Haven, Conn. The Westport company supplies both electrical and water service in Westport, Saugatuck and Green Farms.

WILMINGTON, DEL.—The Public Utilities Light, Heat & Power Company has applied for a franchise to erect and operate an electric plant in Wilmington.

WASHINGTON, D. C.—Sealed proposals will be received at the office of the General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., until Sept. 23, for furnishing copper conductor bars and splice bars. Blanks and general information relating to this circular (No. 647) may be obtained at the above office or at the offices of the assistant purchasing agents, 24 State Street, New York. N. Y.; 614 Whitney-Central Building. New Orleans, La., and 1086 North Point Street, San Francisco, Cal. Major F. C. Boggs is General Purchasing Officer.

WASHINGTON, D. C.—Bids will be received until Sept. 11 at the office of the General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for furnishing vitrified tiles, mandrels for tile, dynamite, calcium carbide and telephone cable. Blanks and general information relating to this circular (No. 645) may be obtained from the above office or from the offices of the assistant purchasing agents at 24 State Street, New York, N. Y.; 614 Whitney-Central Building, New Orleans, La., and 1086 North Point Street, San Francisco, Cal. Major F. C. Boggs is General Purchasing Officer.

ST. PETERSBURG, FLA.—Arrangements are being made by the St. Petersburg Railway & Electric Company to build an extension from St. Petersburg to Coffeepot Bayou, work on which will begin soon.

TAMPA, FLA.—Judge Bullock, of Ocala, Fla., is reported to be interested in a project to build a hydroelectric plant on the Wekiwa River to supply electricity in that district. Plans are under way to form a company to operate the plant.

HONOLULU, HAWAII.—The contract for furnishing boilers, etc., for auxiliary power plant equipment at naval station, Pearl Harbor, has been awarded to C. C. Moore & Company, 99 First Street, San Francisco, Cal., at $158,000, bids for which were opened July 8.

MIDDLETON, IDAHO.—The Swan Falls Power Company, of Nampa, Idaho, is reported to have completed plans for the erection of a substation in Middleton, to cost about $2,500.

MINERAL, IDAHO.—The Idaho Electric & Power Company is planning to erect a pumping station near Mineral for the purpose of pumping water for irrigating land surrounding Mineral on the Snake River. The company is now securing the right of way for the erection of its transmission lines.

CHICAGO, ILL.—Sealed bids will be received by the Board of Trustees of the Sanitary District of Chicago, Room 1500, American Trust Building, Chicago, Ill., until Sept. 5 for furnishing and installing electrical apparatus as follows: Division A—electrical equipment for Wabansia substation; B—tubular poles; C—wrought-iron tubes; D—malleable-iron cross-arms; E—insulators; F—Columbian pole bases; G—ampere meters; H—oil switches; I—line construction; J—watt-hour meters; also for construction of substation building. Plans, specifications and contract form are on file at the office of the electrical engineer of Sanitary District, Room 1500, American Trust Building, Chicago, Ill., copies of which may be obtained on application to above office.

ELLIOTT, ILL.—The installation of an electric-light plant is reported to be under consideration by the city.

GEORGETOWN, ILL.—The new electric-light plant of the Georgetown Electric Light Company is nearly completed and will soon be put in operation. The plant, which is located near the Sharon coal mine, will supply electricity for lamps and motors in the towns of Ridgefarm, Georgetown, Indianola, Sidell, Vermilion Grove and to many of the farmers along its transmission lines.

HILLSBORO, ILL.—Surveys are being made for an electric railway from Hillsboro to Taylor Springs. Funds for building the proposed railway, it is said, will be provided by the Hillsboro Electric Light & Power Company.

MANHATTAN, ILL.—The Village Board has appointed a committee to confer with the Economy Light & Power Company in regard to lighting the streets of the village. The company has submitted a proposition offering to extend its transmission lines from Elwood and to furnish thirty-three street lamps at $44 each per year.

WAUKEGAN, ILL.—The installation of an electric-light plant in connection with the municipal water-works system, to supply electricity for street lighting in Waukegan, is under consideration.

SOUTH BEND, IND.—Work has commenced on the addition to the power house of the Indiana & Michigan Electric Company. An additional unit will be installed which will double the capacity of the present plant, making the output about 13,000 hp.

WARREN, IND.—The Mills Electric Company, of Chicago, Ill., manufacturers of electric chafing dishes, toasters, water heaters and other electrical devices, has moved its plant to Warren, Ind. The factory will be equipped for electrical operation, energy for which will be supplied by the municipal electric-light plant. The management of the municipal electric plant is making a specialty of supplying electricity for small manufacturing plants. W. H. Hickerson is superintendent of the municipal electric plant.

BOONE, IA.—Contracts have been placed by the Boone Electric Company for the construction of a new power house and smokestack. The building will be 80 ft. x 100 ft., built of brick and concrete, and the smokestack 175 ft. high. New equipment will be installed in the new power station, contracts for which have already been placed.

NEW SHARON, IA.—The erection of a high-tension transmission line between Oskaloosa and New Sharon is under consideration. When the present legal tangle in which the electric-light proposition is involved has been solved, it is probable that the city will secure electrical service from the Oskaloosa Traction & Light Company, and a twenty-four hour service will be established.

POCAHONTAS, IA.—At a special election held recently the proposition to issue bonds to the amount of $11,000, the proceeds to be used for the construction of a municipal electric-light plant, was carried.

VILLISCA, IA.—Claiming that the Villisca Electric Company has forfeited its franchise, the City Council has adopted a resolution canceling the franchise of the company, now known as the Villisca Public Service Company. Notice has been served on the company that it must remove its poles and wires from the streets of the city within thirty days. William Binkley is local manager.

CLAFLIN, KAN.—The local electric-light plant was destroyed by fire on Aug. 18. At present the city is without street-lighting service.

LECOMPTON, KAN.—At an election held recently the proposition to issue $2,500 in bonds, the proceeds to be used to install an electric-lighting system, was carried.

NESS CITY, KAN.—At a special election held Aug. 16 the proposition to issue $16,000 in bonds, the proceeds to be used for rebuilding the municipal electric-light plant, was carried. Contracts, it is said, will be let at once for erection of new building and installation of machinery.

TOPEKA, KAN.—The contract for erecting an electric transmission line from the plant of the Topeka Edison Company, in Topeka, to the Industrial Institute, 2 miles east of the city, wiring the grounds for street lamps and also wiring the seven buildings of the institution, has been awarded to H. B. Howard, of Topeka, Kan.

HICKMAN, KY.—The Kentucky Southwestern Railway, Light &

Power Company, recently organized, is planning to build an electric railway from Paducola to Hickman, Ky., and also to supply electricity for lamps and motors. E. F. Wheaton, of Hickman, Ky., is interested in the company.

LEXINGTON, KY.—It is reported that contracts have been awarded by the Kentucky Traction & Terminal Company for machinery and equipment for its proposed power plant. Work will soon begin on construction of the power house. The equipment will include two 2500-kw turbo-generators, two 750-kw auxiliaries and two 75-kw exciters, superheater and four boilers with a rating of about 1000 hp each, each supplied with automatic coal stokers. The company also contemplates the erection of an ice plant and two substations, one on the Nicholasville line, the other on the Georgetown line, and will also rebuild substations on the Frankfort and Paris line. The cost of the work is estimated at about $500,000. Sargent & Lundry, of Chicago, Ill., are consulting engineers.

NEWPORT, KY.—The contract for supplying the city of Newport with electrical energy has been awarded by the City Council to the Union Light, Heat & Power Company, of Covington, Ky. The contract provides that the city shall pay $58 per lamp for arc lamps and $27 per lamp for tungsten lamps. The rate for commercial lighting has not been fixed, but the amount used is at the scale of 10 cents per kw-hour, with a discount of from 10 to 40 per cent according to the amount of energy consumed.

OWENSBORO, KY.—Improvements are contemplated to the municipal electric-light plant which will involve an expenditure of about $16,000. E. H. Bridenback, manager of the municipal plant, will have charge of the work.

ATHENS, MAINE.—Plans are being considered for the construction of an electric railway from Skowhegan to Athens, via East Madison, a distance of about 10 miles. The towns of Athens and Skowhegan have each voted to take $15,000 in capital stock and the Maine Central Railroad Company has promised an equal amount. It is proposed to issue $75,000 in capital stock and to secure the remainder of the funds by sale of bonds. J E. Chapman is interested in the project.

FREDERICK, MD.—The Frederick Railroad Company has purchased the capital stock of the Frederick Gas & Electric Company and has asked the Public Service Commission to ratify the sale. Improvements to the lighting system have been promised the city.

BRANT ROCK, MASS.—The Marshfield Electric Light & Power Company has applied for a franchise to erect and maintain transmission lines for the distribution of electricity in Brant Rock. E. J. Beattie is president of the company.

BARAGA, MICH.—Preparations are being made for the installation of a municipal electric-light plant in Baraga, to cost approximately $30,400. George F. Druer, of Duluth, Minn., is engineer in charge.

BAY CITY, MICH.—At a special election held recently the citizens voted to confirm the franchise granted to Alex. J. Groesbeck, of Detroit, Mich., for an entrance into Bay City by an extension of the Saginaw & Flint Interurban Railway. This city will be made the new terminal with barns, and substation when the hydroelectric development on the Au Sable River is completed. The company agrees to give a local street-car service at a three-cent fare, and also to pay the city 3 per cent of its earnings after the gross receipts reach $15,000 annually.

BEAR LAKE, MICH.—At an election held Aug. 17 the proposition to grant an electrical franchise was granted. Under the terms of the franchise the company is to begin work on construction of its plant within three months. It is proposed to build a dam on the south branch or Little Manistee River first. Power generated by this dam will be utilized in construction of the others, which will be built on the main branch of the Manistee.

BIG RAPIDS, MICH.—The construction of a dam and power plant on the Muskegon River at Ryan's Creek is under consideration by the town of Big Rapids, Mich. The cost of the proposed plant is estimated at about $250,000. Options have been taken by the city of the land on both sides of the Muskegon River. Plans are being prepared by Ray King, engineer.

GRAND RAPIDS, MICH.—The Grand Rapids-Muskegon Power Company is planning to extend its service to Spring Lake this season and possibly to Ferrysburg and Grand Haven. The line will be extended from Fruitport. The company had hoped to extend the service this season to North Park and Mill Creek, but owing to so many demands for city extensions it has been postponed to next season.

STANTON, MICH.—The proposition to issue bonds to the amount of $10,000, the proceeds to be used for the installation of a municipal electric-light plant, was carried.

FERGUS FALLS, MINN.—The City Council is considering the question of issuing bonds for the reconstruction of the dam in connection with the municipal electric-light plant.

RED CLOUD, MINN.—Sealed bids will be received by the city of Red Cloud at the office of the Light and Water Commissioner until Sept. 5 for furnishing and installing the following apparatus: One 120-hp high-speed, automatic compound engine with extension bed plate and outboard bearing for direct connection to a 75-kw generator, one 75-kw, three-phase, 60-cycle, 2200-volt, engine type revolving field generator, one 3½-kw, 125-volt compound wound, direct-current, belted exciter, one standard generator switchboard panel, 1½ in. x 24 in. x 48 in. blue Vermont marble with instruments, one syncroscope, one 50-amp, three-phase, 60-cycle, 2200-volt station watt meter. Alternative bids will be received as follows: No. 1—One 120-hp simple high-speed, automatic engine with extension base and outboard bearing for reception of 75-kw electric generator, one 75-kw generator, same as original proposal, one 3½-kw exciter, same as original proposal, one switchboard, same as original proposal, one syncroscope, one station meter, same as original proposal. Alternative proposals No. 2 will be received as follows: One 120-hp simple belted Corliss engine, 65 ft. 12-in. two-ply leather belting, one 75-kw, 900 r.m.p. revolving field, three-phase, 60-cycle, 2200-volt belted generator, rest of the apparatus same as original proposal. Specifications may be seen at the office of the Light and Water Commissioner. D. H. Rich is Light and Water Commissioner.

THIEF RIVER FALLS, MINN.—The proposition to issue $40,000 for the installation of an auxilliary steam plant will soon be submitted to a vote of the people. If the proposition is carried the grounds at the pumping station will be used as the site.

TOWER, MINN.—Contracts have been awarded by the City Council for the construction of the municipal electric-light plant as follows: For construction of dam and power house at Pike River Falls to the H. L. Bartlett Company, at $11,738; transmission line to Bowe & Barker, for $4,474; for turbine and head-gate hoist to Dayton Globe Iron Works, at $2,224, and to the Fort Wayne Electric Works for generators and electrical machinery, at $2,690, making a total of $21,126. Work will begin at once on the construction of the proposed plant.

KANSAS CITY, MO.—Plans and specifications prepared by the McLaughlin Engineering Company, it is reported, have been approved by the City Commissioners. The city clerk has been authorized to call for bids for the construction of the proposed plant immediately.

KIRKSVILLE, MO.—The City Council has accepted the proposition submitted by William Brannan for the construction of the power house for the proposed municipal electric-light plant, for $3,750.

LACLEDE, MO.—The city of Laclede has granted a franchise to Percy W. Markham, superintendent of the Brookfield Electric Light Company, to supply electricity in this city. A company has been organized and a transmission line will be erected at once from the plant of the Brookfield Electric Light Company in Brookfield, to Laclede, a distance of 5 miles.

CHOTEAU, MONT.—It is reported that the local electric-light plant owned by Julius Hirschberg has been purchased by H. McCullough, of Corbin. It is understood that the new owner will make improvements to the plant.

COLUMBIA FALLS, MONT.—The Columbia Falls Telephone Association, recently incorporated with a capital stock of $40,000, is reported to be contemplating the erection of telephone lines throughout Flathead County. The headquarters of the company will be located in Columbia Falls.

MISSOULA, MONT.—The Missoula Light & Power Company is reported to be contemplating the installation of a new street-lighting system, to cost about $10,000.

NEWARK, N. J.—A contract was recently signed at the office of R. Lum, Firemen's Building, Newark, between the Light Committee of Union Township and the Public Service Electric Company for the installation by the latter of a street-lighting system in Union Township, and work is to be commenced at once. The Public Service Company agrees to place 90 lamps in different parts of the township, and maintain them for one year at a rate of $20 each. An appropriation of $1,800 was made in June to cover the cost of this installation.

PATERSON, N. J.—The Public Service Corporation has submitted a proposition to the road committee of the Board of Freeholders offering to supply street lamps for the county roads at $97 each per year until such time as a contract is entered into between the Board of Freeholders and the Public Service Corporation. Under the old contract the county paid $140 per lamp per year.

TRENTON, N. J.—The Trenton Street Railway Company has filed a certificate with the Secretary of State increasing its capital stock from $1,000,000 to $2,500,000. With the exception of one share to be held to qualify each of the directors, the stock is all held by the United Power & Transportation Company.

ELEPHANT BUTTE, N. M.—The contract for machinery for the new power plant of the reclamation service, to be used in constructing the dam at Elephant Butte, has been awarded to W. E. Anderson, of El Paso, Tex.

MOGOLLON, N. M.—The Ernestine Mining Company has commenced work on its proposed new power plant.

BINGHAMTON, N. Y.—At an election held Aug. 25 the proposition to issue bonds, the proceeds to be used for removal of poles and wires from Court Square and for installation of ornamental lamps, was carried. S. W. Murray is city clerk.

FREEPORT, N. Y.—It is reported that extensive improvements are contemplated to the municipal electric-light plant, which will involve an expenditure of about $10,000.

GLOVERSVILLE, N. Y.—The Fulton County Gas & Electric Company has applied to the Public Service Commission, Second District, for permission to make reductions in the rates of electricity for lamps and motors in the cities of Johnston and Gloversville. The rates for lamps are reduced from 5 cents, 8 cents and 10 cents per kw-hour to 4 cents and 9 cents per kw-hour, depending on the amount consumed. The rates for

energy for motors under the new rates will be from 1½ cents to 9 cents per kw-hour, instead of from 2½ cents to 10 cents. The reduction is voluntary on the part of the company.

KEESEVILLE, N. Y.—The Public Service Commission, Second District, has granted the Keeseville Electric Company authority to exercise franchises for the distribution of electricity in the towns of Jay, Essex County, and Ausable, Clinton County, to erect a transmission line 15 miles in length from Ausable Chasm through these towns and also to supply electricity in the hamlet of Ausable Chasm.

LITTLE FALLS, N. Y.—The City Council has granted the Little Falls & Johnston Railway Company a franchise to construct and operate an electric railway from Little Falls to Johnstown.

NEW YORK, N. Y.—The contract for installing electric equipment in the Washington Irving High School, borough of Manhattan, bids for which were opened Aug. 21, has been awarded to the New York Construction Company, for $37,840.

NEW YORK, N.Y.—Bids will be received at the office of the Quartermaster, United States Army, Fort Jay, Governor's Island, N. Y., until Sept. 5, for furnishing at Pier 12, East River, New York, N. Y., one Thompson polyphase watt-hour meter, two current transformers, 36 ceiling bands, 24 crystal ball shades and 75½ ft. rubber matting. Captain F. H. Burton is quartermaster.

NEW YORK, N. Y.—Sealed bids will be received by Patrick A. Whitney, Commissioner of Correction, Department of Correction, 148 East Twentieth Street, borough of Manhattan, New York, N. Y., until Sept. 7 for furnishing labor and material for the installation of a three-wire, 110-220-volt lighting system in building No. 5, known as the branch workhouse, Hart's Island, N. Y., together with a service connection and panel board, etc., in building No. 4. Blank forms and further information may be obtained and plans and drawings may be seen at the office of the Department of Correction.

NEW YORK, N.Y.—Bids will be received at the office of the Mayor, Chairman of Armory Board, Hall of Records, Chambers and Centre Streets, New York, N. Y., until Sept. 6, as follows: Item 1—For furnishing labor and material for a complete additional electric-lighting system and wiring in the Twelfth Infantry Armory, located at Sixty-second Street and Columbus Avenue, borough of Manhattan. Item 2—For furnishing and installing electric-light and gas fixtures in the Twelfth Infantry Armory. Plans for items for 1 and 2 may be examined at the office of the Armory Board, Room 6, Hall of Records.

NEW YORK, N. Y.—Bids will be received by Joseph Johnson, Fire Commissioner, Headquarters of the Fire Department of the city of New York, 157 and 159 East Sixty-seventh Street, borough of Manhattan, N. Y., until Sept. 5 for furnishing materials, establishing and equipping an extension of the underground fire-alarm telegraph system on East End Avenue, from Eighty-second Street to Eighty-eighth Street. Bids will also be received at the same time and place for furnishing supplies for the fire-alarm telegraph bureau. Blank forms and further information may be obtained and plans and specifications may be obtained at the above office.

NEW YORK, N. Y.—Sealed proposals will be received by C. B. J. Snyder, Superintendent of School Buildings, Department of Education, corner of Park Avenue and Fifty-ninth Street, New York, N. Y., until Sept. 5, for repairs, alterations and additions to the electric equipment on Public School 30, Wadleigh High School and High School of Commerce, borough of Manhattan. Bids will be received at the same time and place for repairs, alterations and additions to the electric equipment in Public Schools 12 and 14, borough of Richmond. Plans and specifications may be obtained or seen at the above office, and also at Borough Hall, New Brighton, borough of Richmond.

NEW YORK, N Y.—Sealed bids will be received by George McAneny, president of the borough of Manhattan, City Hall, New York, N Y., until Sept. 5, for furnishing labor and material for alterations and additions to the electric light equipment at the court house building, located at 314 West Fifty-fourth Street, borough of Manhattan, as follows: Item 1—For furnishing, installing and connecting the wiring and gas fitting system, complete, including all switches, receptacles, conduits, wiring panel boards, etc., ready for fixtures to be connected. Item 2—For removing, refurnishing, altering and reinstalling old fixtures, complete as specified; also for furnishing, installing and connecting new fixtures and accessories, complete, to outlets, as specified. Item 3—For furnishing all labor and material to complete the entire contract as specified. Blank forms and specifications may be obtained at the office of the auditor, office of the Commisioner of Public Works, Room 1807, 13 to 21 Park Row, New York, N. Y.

NEW YORK, N. Y.—Bids will be received by George McAneny, president of the borough of Manhattan, City Hall, New York, N. Y., until Sept. 5, for furnishing and installing electric light and power fixtures and wiring in the Harlem court house building, located at 121st and Sylvan Place, borough of Manhattan, as follows: Item 1—For furnishing, installing and connecting the wiring and gas-fitting system complete, including all switches, receptacles, conduits wiring, panel boards, etc., ready for fixtures to be connected. Item 2—For removing, refinishing, altering and reinstalling complete as specified; also for furnishing, installing and connecting new fixtures and accessories, complete, to outlets, as specified on plans. Item 3—For furnishing and installing all labor and material to complete the entire contract as specified on plans. Blank forms and specifications may be obtained at the office of the Auditor, office of the Commissioner of Public Works, Room 1807, 13 to 21 Park Row, New York, N. Y.

NEW YORK, N. Y.—Bids will be received by George McAneny, president of the borough of Manhattan, City Hall, New York, N. Y., until Sept. 5, for labor and materials for alterations and additions to electric-lighting equipment at the Jefferson Market court house building, located at Sixth Avenue and Ninth Street, borough of Manhattan, as follows: Item 1—For furnishing, installing and connecting the wiring and gas fitting system, complete, including all switches, receptacles, conduits, wiring, panel boards, etc., ready for fixtures to be connected. Item 2—For removing, refurnishing, altering and reinstalling old fixtures, complete as specified, also for furnishing, installing and connecting new fixtures and accessories, complete, to outlets, as specified on plans. Item 3—For furnishing and installing all labor and material to complete the entire contract. Blank forms and specifications may be obtained and plans examined at the office of the auditor, office of the Commissioner of Public Works, Room 1807, 13 to 21 Park Row, New York, N. Y.

OXFORD, N. C.—It is reported that a company has been organized to erect a hydroelectric power plant on the Tar River, about 8 miles from Oxford.

RUTHERFORDTON, N. C.—Bonds to the amount of $35,000 have been sold by the city of Rutherfordton for the installation of an electric-light plant and water works. B. P. Rucker, of Charlotte, N. C., has charge of the engineering work.

BISMARCK, N. D.—The City Commissioners have authorized the installation of street lamps on the principal streets in the business district.

CLEVELAND, OHIO.—A contract has been signed by Public Service Director Lea with the Fanning Manufacturing Company, operating a large plant in Big Creek Valley, to supply electrical energy generated at the municipal electric-light plant at 1½ cents per kw-hour. Director Lea states that the past year will show a profit of $50,000 for the municipal plant and that it can be built up from its own earnings, so that it will eventually supply electricity for the entire city.

DEFIANCE, OHIO.—Work has begun on the construction of the new hydroelectric plant of the Anglaize Power Company, on the Anglaize River, 2 miles south of Defiance. The cost of the entire plant is estimated at about $500,000. Plans have been completed for a second plant at Oakwood, about 9 miles farther up the river, and a third plant will be located later on. The plans contemplate the development of about 17,000 hp. Orders have been placed with the Allis-Chalmers Company, of Milwaukee, Wis., for equipment of the Defiance plant.

LIMA, OHIO.—Bids will be received by George E. Whitney, secretary of Commmission, until Sept. 15 for 1600-hp water tube boilers, in 200-hp units; six engines ranging from 135 to 265 hp; six generators ranging from 75 kw to 150 kw; an eleven-panel switchboard and necessary equipment of heaters, pumps and pipe. Plans are on file at the office of J. G. Lorimer, superintendent of construction, at the building site, near Lima, Ohio, and at the office of F. L. Packard, architect, 1214 New Hayden Building, Columbus, Ohio.

MIDDLEPORT, OHIO.—The village of Middleport is contemplating the installation of a combined water and light plant. An option has already been taken on the local electric-light plant.

MOUNT VERNON, OHIO.—The contracts for furnishing material and installing the feed wires and yard lamps at the Ohio Sanitarium (bids opened Aug. 12) has been awarded to the Erner Hopkins Company, Columbus, for $10,299, with deductions for alternates of $5,320.

NELSONVILLE, OHIO.—John A. Stewart, president of the Hocking Electric Power Company, has secured a site near Nelsonville, Ohio, in the Hocking Valley coal field, and plans have been completed for the erection of a power station and installations of a 10,000-kw plant. Electricity generated at this plant will be distributed in the various towns and villages in that section. The company is now operating a small plant in Nelsonville and has made a proposition to the Village Council of Athens to take over the municipal plant and supply electricity for lamps and motors in that place at a price of 25 per cent less than the present cost of production.

NEWARK, OHIO.—Announcement has been made that the stock of the Licking Light & Power Company, of Newark, Ohio, has been sold to the American Gas & Electric Company, of New York, N. Y. M. M. Gillette and others of Newark, Ohio, owned a controlling interest in the company. It is said that the plant and transmission system will be practically rebuilt. H. L. Montgomery, formerly manager of the Auburn Light, Heat & Power Company, of Auburn, N. Y., has been appointed manager of Licking Light & Power Company and F. C. Morrison will be assistant manager.

NORWOOD, OHIO.—The City Council is reported to have passed an ordinance providing for a bond issue, the proceeds to be used to install an ornamental lighting system on Montgomery Avenue.

MULDROW, OKLA.—The installation of an electric-light plant and water-works system in Muldrow is reported to be under consideration.

BEND, ORE.—The Bend Water, Light & Power Company has applied to the City Council for franchises to construct and operate water and light systems in Bend proper and in Park, North and Central additions. It is proposed to change the ordinance to include Lava Road, Deschutes and probably other additions.

BURNS, ORE.—James D. Fellows, who was recently granted a twenty-

five-year franchise, is making arrangements to install an electric-light plant in Burns.

EUGENE, ORE.—The Oregon Power Company, owned and operated by H. M. Byllesby & Company, of Chicago, Ill., has submitted a proposition to the City Council, offering to purchase the municipal electric-light plant on the McKenzie River and distributing system at cost price plus 10 per cent and to enter into a contract to supply electricity for pumping the city water for a term of twenty-five years at prices materially lower than ever offered before; also to reduce the maximum rate for electricity for lamps from 15 cents per kw-hour to 11 cents, which will give a rate of 9.9 cents on all bills paid within ten days. The company also agrees to install at its own expense ornamental lamp standards for street-lighting purposes. E. Groesback, of Portland, Ore., is president of the company.

GRANTS PASS, ORE.—The Golden Drift Dam Company, it is reported, is contemplating building a large hydroelectric plant on Rogue River.

KLAMATH FALLS, ORE.—It is reported that an electric power plant will be installed at the new mill being erected by the Pellican Lumber Company. About 800 lamps will be installed.

MEDFORD, ORE.—It is reported that the residents of Griffin Creek have voted to erect a transmission line along Griffin Creek to supply electricity for lamps and motors to the county rock quarry and to about forty farms.

MEDFORD, ORE.—The Siskiyou Electric Power and Light Company, of Yreka, Cal., has purchased the property of the Rogue River Electric Company, which gives the former company control of the water resources of northern California and southern Oregon. The consideration is said to be $3,300,000. When the work now under way is completed the company will have a total output of 80,000 hp at low water periods, and 800 miles of high-tension transmission lines will be erected to carry the energy generated at its plants. J. W. Churchill, of Yreka, Cal., is president of the company.

PHILOMATH, ORE.—The Oregon Power Company is making extensive improvements to its system in this section. A new transmission line has been built from Cornvallis. The cost of the work is estimated at $15,000.

PORTLAND, ORE.—The Oregon-Washington Railroad & Navigation Company will soon commence construction of its private telephone line between Portland, Tacoma and Seattle, Wash., about 150 miles in length. A. A. Klippel, superintendent of telegraph, is in cnarge.

SALEM, ORE.—The Portland Railway, Light & Power Company is planning to install a system of cluster lamps in Salem.

ALTOONA, PA.—The Penn Central Light, Heat & Power Company has taken over a number of newly formed electric companies in Cambria, including those at Gallitzin, Cresson, Blacklick, Allegheny and several townships. The company is planning an extension of its transmission lines into the Cambria field to supply electricity generated at its hydroelectric plant at Warriorsmark. A trunk line has already been erected as far as Delany to supply energy to the coal mines.

HAZLETON, PA.—The Hardwood Power Company has closed contracts with the Lehigh Valley Coal Company, Coxe Brothers, Inc., and the Wyoming Valley Water Company to furnish electrical energy to operate the plants of the respective companies in the Lehigh region. The contract with the coal company is for furnishing electricity at the following collieries: Drifton, Oneida, Tomhicken, Derringer, Eckley, Hazleton Shaft, Hazle Mines, Jeanesville and Yorktown, and for the water company to supply energy for operating the plant at Harwood and the two reservoirs at Dreck's Creek when completed.

JOHNSTOWN, PA.—The Citizens' Light, Heat & Power Company is contemplating extensive improvements and additions to its plant. H. H. Weaver, vice-president and general manager, has resigned the duties connected with the latter position, but will continue as vice-president. P. J. Morrisey, formerly connected with the Detroit Edison Company, has been appointed general manager.

LORETTO, PA.—It is reported that negotiations are pending between the Borough Council and the Franciscan Fathers of St. Francis College with a view of securing electricity for lighting the streets and residences of the borough.

PHILADELPHIA, PA.—The Philadelphia Rapid Transit Company has applied for a charter for the Snyder Avenue Railway Company to build a double-track electric railway on Snyder Avenue from Delaware Avenue to Thirty-sixth Street in South Philadelphia, Pa. The incorporators are: Charles O. Kruger, president of the Rapid Transit Company; Alexander Rennick, James J. Springer, George W. Mantz and W. L. Maize.

WEATHERLY, PA.—The installation of an electric-light plant in Weatherly, to cost about $10,000, is reported to be under consideration.

PORTSMOUTH, R. I.—The power plant at the Reginald C. Vanderbilt estate in Portsmouth was destroyed by fire on Aug. 23, causing a loss of about $10,000.

ARLINGTON, S. D.—Plans are being considered by W. C Allen and Adam Royin for the installation of an electric-light plant in Arlington.

SIOUX FALLS, S. D.—The power plants of the Sioux Falls Light & Power Company and the Bennett Light & Power Company, recently purchased by H. M. Byllesby & Company, of Chicago, Ill., have been consolidated. Announcement has been made that the new owners will make extensive improvements and extensions to the property, involving an expenditure of about $225,000.

WATERTOWN, S. D.—The City Council has granted Ferris Brothers, owners of the local electric-light and power plant, a twenty-year franchise to construct and operate a street railway with a line to Lake Kampeskia. Work will begin at once on the extension to the lake.

WHITE LAKE, S. D.—The City Council has granted the White Lake Light & Power Company a franchise to construct and operate an electric-light plant in White Lake. It is understood that work on the proposed plant will begin in the near future.

BONHAM, TEX.—The Bonham Gas & Electric Company has awarded the contract for a power house, to be erected on East Second Street. The present power house of the company is located at the terminus of the electric street-car line in Russell Heights, but is to be moved inside of the city limits. New machinery will be installed.

BRISTOL, TENN.—The city of Bristol is considering the question of establishing a municipal electric-light plant. In order to issue bonds it will be necessary to secure authority from the State Legislature.

BRISTOL, TENN.—The Watauga Power Company has nearly completed its hydroelectric plant on the Watauga River and is erecting transmission lines to the nearby cities. The company has contracted for the sale of a large part of the output of the plant to the Bristol Gas & Electric Company.

GALLATIN, TENN.—Contracts have been awarded by the Board of Mayor and Aldermen for machinery and equipment for the combined electric-light plant and pumping station as follows: To the Allen Engineering Company, of Memphis, Tenn., for one Chuse automatic non-releasing Corliss valve engine and two centrifugal pumps, and to the Crocker-Wheeler Company, of Ampere, N. J., for generators and switchboards, etc. The cost of the equipment is estimated at $8,075.

CHATTANOOGA, TENN.—The Georgia Power Company, it is said, has decided to extend its transmission lines to Chattanooga to supply electricity for power purposes. The company will soon apply to the City Council for a franchise. The company will also supply electricity to small towns along its lines.

LEXINGTON, TENN.—The installation of an electric-light plant and water-works system in Lexington is under consideration.

AMARILLO, TEX.—The City Council has granted a severance of the franchise of the Amarillo Water, Light & Power Company, in consideration for which the company has reduced the price of electricity for lamps 25 per cent and increased the supply of water 33 1-3 per cent at the old rate. It is understood that the capital stock of the company will be increased and a larger plant erected.

BRYAN, TEX.—At an election held on Aug. 21 the proposition to issue $20,000 in bonds for the completion of the municipal water, light and sewer systems was carried.

GARRISON, TEX.—R. T. Patterson is installing an electric-light plant in Garrison.

HOUSTON, TEX.—The Tel-Electric Company, of Houston, has amended its charter, increasing the capital stock from $50,000 to $100,000.

TEXARKANA, TEX.—The Texarkana Gas & Electric Company recently filed an amendment to its charter with the Secretary of State increasing its capital stock from $200,000 to $600,000.

WACO, TEX.—The proposition submitted to the City Commissioners by the Waco Gas & Electric Company to furnish street lamps at $72 per lamp per year has been rejected. The city pays $98 per year per lamp under the present contract, which has three years to run.

WEATHERFORD, TEX.—Plans are being considered for removing the power house of the Weatherford Water, Light & Ice Company from its present site to another part of the town. The present plant is located in the thickly settled portion of the city. The citizens propose to assist the company in making the proposed change.

BRIGHAM CITY, UTAH.—The Town Board of the newly incorporated town of Honeyville has decided to call an election to vote on the proposition to issue bonds to the amount of $12,000, the proceeds to be used for the installation of an electric-light system and water works. It is proposed to install a distributing system and purchase electrical energy from some power company.

DANVILLE, VA.—The Scofield Engineering Company, consulting engineer, Philadelphia, Pa., has been engaged to prepare plans and specifications and supervise the construction of the new electric-light plant to be built by the city of Danville. Frank Talbott is purchasing agent and treasurer of the Water & Light Departments.

HAMPTON, VA.—The City Council has awarded the contract for street lighting to the Newport News & Old Point Railway & Electric Company for a period of five years, under the terms of which the company is to furnish arc lamps at $75 each per year with all-night service; tungsten cluster lamps, with all-night service, at $45 each per year, and midnight service at $35 each per year, and also 60-cp tungsten lamps at $20 per lamp per year.

RICHMOND, VA.—It is reported that the Virginia Railway & Power Company is negotiating with the American Railways Company, of Philadelphia, Pa., for the purchase of the Roanoke and Lynchburg traction properties.

BELLINGHAM, WASH.—Preparations are being made by the Balfour-Guthrie Cement Company for the erection of a large cement plant

in the northern part of the city. It is understood that the plant will be equipped for electrical operation throughout.

CENTERVILLE, WASH.—It is reported that the Pacific Light & Power Company is planning to supply electricity in Centerville for lamps and motors and also to supply electrical service to the farmers in this district from its plant located on the Little Klickitat River.

HUSUM, WASH.—T. M. Cole is planning to erect a power plant on Rattlesnake Creek, to supply power for pumping and irrigation work.

LYLE, WASH.—The Northwestern Electric Company, of Portland, Ore., has commenced work on the construction of its large dam on the Klickitat River. An 8000-kw hydroelectric plant is to be erected. Newell, Grossett & Walsh, of Portland, Ore., are engineers.

OLYMPIA, WASH.—The State Board of Control will receive bids until Sept. 15 for electrical equipment for the Northern Hospital for Insane at Sedro-Woolley. Plans and specifications are on file at the office of Saunders & Lawton, architects, Seattle, Wash.

SPOKANE, WASH.—The Inland Empire Paper Company, operating at Millwood, is contemplating the erection of a large power plant. The cost of the plant is estimated at $400,000.

STEVENSON, WASH.—The organization of a new company, to be known as the Cleom Tumwater Light & Power Company, for the purpose of building a power plant on the Wind River, about 18 miles north of Stevenson, is under consideration. It is estimated that about 6000 hp can be developed. E. P. Ash and S. Samson are interested in the project.

SUMAS, WASH.—A municipal electric-lighting system is to be installed in this city, the cost of which is estimated at $7,000.

SUMAS, WASH.—It is reported that the Stone & Webster Management Association has contracted with the Western Canadian Power Company, of Vancouver, B. C., Can., for 6500 hp generated at the Stave River Canyon plant. The Stone & Webster Company, it is said, will erect a transmission line to Sumas, where the energy will be delivered by the Canadian company.

TACOMA, WASH.—The Park Board has awarded a contract for the installation of a conduit lighting system, with ornamental lamp standards, in Wrights Park to Evans & Dickson, to cost about $4,000.

TACOMA, WASH.—A conduit arc-lighting system, consisting of forty-two lamps, will be installed in the Stadium. Estimated cost of work, $2,800, plans for which have been prepared by Frederick Heath, architect.

TACOMA, WASH.—The main lines of the municipal electric-light system will have to be rebuilt before electricity generated at the Nisqually municipal power plant can be utilized. The cost of the work is estimated at about $100,000, funds for which will be obtained from the earnings of the light plants. It is expected to have the Nisqually plant ready to put in operation by July, 1912.

VANCOUVER, WASH.—Application has been made to the Council by Lawrence Harmon for a franchise to install a telephone and telegraph system and also for the construction of a street-car system in Vancouver.

MINOCQUA, WIS.—The contract for installing the new lighting system in Minocqua has been awarded to the Central Construction Company, of Oshkosh, Wis. The cost of the system is estimated at about $7,500.

MUSCODA, WIS.—It is reported that extensions and improvements are contemplated to the municipal electric-light plant, for which bonds to the amount of $5,000 have been voted.

VANCOUVER, B. C., CAN.—Another company, it is said, will soon apply for a franchise to extend its high-tension transmission lines through Vancouver. The company is now securing franchises in the smaller towns in Clark County. It is proposed to utilize the water-power of the east fork of Wind River, where it is estimated that about 5000 hp can be generated. The company is planning to supply electricity to any point along the route to Vancouver from Washougal.

SELKIRK, MAN., CAN.—The Town Council has entered into a contract with the Winnipeg, Selkirk & Lake Winnipeg Railway Company, operated by the Winnipeg Electric Railway Company, to supply electrical energy to the amount of 100 hp at $30 per hp per year. The town will erect its own distributing system. It is proposed to supply electricity for lamps at rates now prevailing in the city of Winnipeg.

WINNIPEG, MAN., CAN.—Bids will be received until Sept. 11 by M. Peterson, secretary of Board of Control, for furnishing and delivering f.o.b. Winnipeg, Man., the following supplies: Section A—Mercury-arc transformers and rectifiers. Section B— Magnetite or metallic flame-arc lamps. Section C—Electrodes. Section D—Inner and outer globes. Specifications, etc., may be secured at the office of the general manager of the City Light and Power Department, 449 Main Street, Winnipeg, Man.

WINNIPEG, MAN., CAN.—Announcement has been made by the Winnipeg Electric Railway Company of a reduction in the rates of electricity for lamps as follows: Beginning Sept. 19 the rate will be 7½ cents per kw-hour, with a discount of 10 per cent on all bills amounting to $10; 15 per cent discount on all bills over $10 and up to $15; 20 per cent on all bills over $15 and up to $20. On bills over $20 larger discounts will be given. Wilfred Phillips is general manager of the company.

PORT STANLEY, ONT., CAN.—Plans are being considered by the city to install a hydroelectric light and power plant, the cost of which is estimated at about $12,750.

SARNIA, ONT., CAN.—The Town Council has adopted a by-law authorizing the purchase of the property of the Sarnia Gas & Electric Company at $125,000. It is not expected that the company will accept this price, but the amount will form the basis of arbitration proceedings to determine the value of the plant, after which another by-law will be submitted to the ratepayers.

TORONTO, ONT., CAN.—Plans are being made by the city of Toronto to call for tenders for construction of double-track subways, approximately 3 miles in length, on or about Sept. 15. G. R. Geary is Mayor.

PACHUCA, HIDALGO, MEXICO.—Electricity is playing an important part in the construction of a mining tunnel known as the Nepton tunnel, which when finished will be a little over six miles long. It is being constructed by Gabriel Mancera, an engineer, of Mexico City. He has installed near the mouth of the tunnel an electric power plant to supply energy for drilling and which also provides electricity for the lighting system and for operating ventilating fans. This tunnel will traverse the underground mineral region at a depth of about 1400 ft. below the surface of the city of Puebla. It was started eighteen years ago and there has been finished up to this time about two miles of the work. Its special object is to drain the whole Pachuca mining district and to afford an outlet for the ores of the different mines with which it will connect. An electric-tramway system will be installed in the tunnel when the work has made a little further progress.

New Industrial Companies.

THE ANGELUS ELECTRIC CREMATORY COMPANY, of Los Angeles, Cal., has been granted a charter with a capital stock of $100,000. The incorporators are: J. L. Brown, J. E. Youtz, H. Schroeder, F. A. Parker and C. C. Pierce.

THE ATLANTIC PERFECTED MOTOR COMPANY, of Atlantic City, N. J., has been incorporated by Frank Brown, Thomas Kilcurse, Samuel S. Phoebus and John S. Ingram, all of Atlantic City, N. J. The company is capitalized at $20,000 and proposes to manufacture motors, engines, etc.

THE BUYER ELECTRICAL & SUPPLY COMPANY, of New York, N. Y., has been incorporated by Maurice Hogler, Richard Buyer, Louis Goldin and Fred Kuehne. The company is capitalized at $5,000 and proposes to do general electrical work.

THE COMER MANUFACTURING COMPANY, of borough of Queens, N. Y., has been incorporated by John J. Comer, of Springfield Road, borough of Queens, N. Y.; Edward C. Baxter, of Smithtown, N. Y., and Albert F. Donnelly, of Springfield Road, borough of Queens, N. Y. The company is capitalized at 10,000 and proposes to manufacture gas fixtures, gas and electric chandeliers.

THE DAVIES ELECTRIC COMPANY, of Albany, N. Y., has been chartered with a capital stock of $5,000 to do a general electrical and mechanical engineering business. The directors are: William P. Davies, William T. Poole and Richard E. Ellis, of Albany, N. Y.

THE IDEAL ELECTRIC INSPECTION & MAINTENANCE COMPANY, of New York, N. Y., has been incorporated by W. E. McKeen, of Brooklyn, N. Y.; S. L. Moxham and F. Lask, of New York. The company is capitalized at $25,000, and proposes to deal in electrical supplies and do an electrical contracting business.

THE CHARLES A. JACKSON COMPANY, of Boston, Mass, has been incorporated with a capital stock of $25,000 for the purpose of manufacturing electrical fixtures. The directors are: Edith L. Jackson, president; Charles A. Jackson, 55 Stanhope Street, Boston, Mass., treasurer, and Harry A. Patterson.

THE GEORGE W. JACKSON ENGINEERING COMPANY, of Yonkers, N. Y., has been incorporated by Harold R. Griffith, 17 West Eighth Street; J. C. Connell, 99 East Eighty-first Street, both of New York, N. Y., and Francis L. Madden, of Ossining, N. Y. The company is capitalized at $300,000 and proposes to do a general mechanical engineering business.

THE McDONALD GIBSON COMPANY, of borough of Bronx, New York, N. Y., has been incorporated with a capital stock of $25,000 to manufacture patent mechanical and electrical devices, etc. The incorporators are: J. C. McDonald, W. Gibson and D. M. Macdonald, all of New York, N. Y.

THE NATIONAL UTILITY COMPANY, of New York, N. Y., has been granted a charter with a capital stock of $5,000 to manufacture electrical goods. The incorporators are: John T. Booth, John Dill, Paul Jeppener and Louis V. Hulse.

THE SALEM BATTERY COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $10,000 to manufacture electric batteries. The incorporators are: J. Hibberd Taylor, John S. Clement, Samuel D. Heed and Edward D. Palmer.

THE SHEDD ELECTRIC COMPANY, of Elizabeth, N. J., has been granted a charter with a capital stock of $50,000. The company proposes to manufacture electric fans, vacuum cleaners, etc. The incorporators are: H. M. Shedd, M. F. Moore, C. W. MacQuoid, of Roselle, and N. R. Leavitt, of Elizabeth, N. J.

New Incorporations.

OAKLAND, CAL.—The Oakland Railways have been incorporated with a capital of $27,000,000 by J. S. Fleming, S. Canham, L. L. Jackson and others, of San Francisco. This is a subsidiary of the United Properties Company.

SAN FRANCISCO, CAL.—The Mill Valley Gas & Electric Company has filed articles of incorporation with a capital stock of $100,000. The incorporators are: L. E. Burks and F. L. Fenton.

DETROIT, MICH.—The Consolidated Light & Power Company has been organized for the purpose of building and operating hydroelectric plants on the Chippewa River. The company owns two dams on the Chippewa River and contemplates the erection of seven more. Electrical service will probably be supplied in St. Johns, Ithaca and Mount Pleasant. The officers of the company are: J. L. Hudson, president; Charles S. Abbott, vice-president and general manager; Robert Tannerhill, secretary, and F. R. Ross, treasurer.

DULUTH, MINN.—The Mesaba Electric Railway Company has been incorporated to construct an electric railway, 35 miles in length, to connect Hibbing, Chisholm, Buhl, Mountain Iron, Virginia, Eveleth and Gilbert. Preliminary arrangements are being made and contracts will soon be awarded for construction of the railway. Application for franchises will be made at once. Oscar Mitchell is president and E. C. Thomas engineer in charge.

ELKO, NEV.—Articles of incorporation have been filed for the Jarbridge Power Company by Gilmore Kenney, Jr., J. M. Kinney, J. T. Brunn and George F. Elliot.

Personal.

MR. LAWRENCE N. B. BULLOCK, metallurgical engineer, is now with the Mexico Mine & Smelter Supply Company, with headquarters at Mexico City.

MR. EDWARD B. FIELIS has been appointed purchasing agent of the New York & Queens Electric Light & Power Company, succeeding Mr. A. R. Hill.

MR. A. P. CONNOR, solicitor of patents, who makes a specialty of electrical patent work, has moved his offices from the Ouray Building to 121 Carroll Street, S. E., Washington, D. C.

MR. SIDNEY RICHARD INCH, secretary-treasurer and manager of the Missoula (Mont.) Light & Water Company, is visiting his home city, London, England, after an absence of ten years.

MR. GEORGE B. TRIPP has resigned as general manager of the Colorado Springs Electric Company in order to go to Harrisburg, Pa., to take charge there of the George Bullock interests.

MR. T. D. SMITH, formerly with the Commercial Electrical Company, of St. Louis, Mo., is now with the electrical department of the Mexico Mine & Smelter Supply Company, located at Mexico City.

MR. WILLIAM H. ARMSTRONG, for many years mill superintendent for the Dos Estrellas Mining Company at El Oro, Mexico, has joined the sales force of the Mexico Mine & Smelter Supply Company at Mexico City.

DR. A. E. KENNELLY sailed Aug. 26 on the *St. Paul* in order to attend the meeting, at Turin, Italy, of the International Electrotechnical Commission, which will be held in connection with the Turin International Electrical Congress.

MR. H. J. BUELL, formerly of the commercial department of the Northern Colorado Power Company, has been made contract agent for the Trinidad Electric Transmission Railway & Gas Company, with headquarters at Trinidad, Col.

MR. E. D. STRICKLAND, assistant to Jupiter (business manager), of the Order of Rejuvenated Sons of Jove, has moved his office, which is the business headquarters of the order, from Chicago to 1412 Syndicate Trust Building, St. Louis, Mo.

MR. D. B. BUTLER, formerly manager of the Albuquerque Gas & Electric Company, has been appointed manager of the Trinidad Electric Transmission Railway & Gas Company, owned by the same holding company—the Federal Light & Traction Company.

MR. THOMAS A. EDISON, who is spending a vacation touring in Europe, narrowly escaped serious injury on Aug. 29 when his automobile was overturned near Geneva. The car was much damaged, but fortunately Mr. Edison was not in the least injured.

MR. J. P. JOLLYMAN, formerly connected with the California Gas & Electric Corporation, and electrical engineer for the Great Western Power Company since early in 1910, has been appointed electrical engineer for the Pacific Gas & Electric Company with headquarters at San Francisco.

MR. W. F. SLOAN and Mr. W. J. Hubble have organized to carry on their advisory and consulting practice under the firm name of Sloan, Hubble & Company, with offices in Madison, Wis. The firm will do a general engineering practice and give especial attention to appraisals, rate-making, engineering examinations and statistical investigations.

MR. C. A. CUMMINGS, formerly connected with the Commonwealth Edison Company, of Chicago, and later with the Federal Sign System, Electric, has accepted a position in the Chicago office of the Fort Wayne Electric Works of the General Electric Company.

MR. FRANK H. PLAICE has resigned his position as general manager of the Winona (Minn.) Railway and Light Company. He has had an exceptional record in building up motor load for central-station companies, not only at Winona, but previously at New Bremen, Ohio, and Hastings, Mich.

MR. ROBERT SIBLEY, formerly consulting hydraulic and electric engineer, of Missoula, Mont., has been appointed associate professor of mechanical engineering at the University of California. He will continue to occupy his present position of editor of the *Journal of Electricity, Power and Gas.*

MR H. T. PLUMB has not resigned as associate professor of electrical engineering at Purdue University, as stated in these columns in the issue of Aug. 5, but has a leave of absence of two years, which is being occupied in work as an engineer in the Denver district office of the General Electric Company.

PROF. F. W. SPRINGER, of the department of electrical engineering of the University of Minnesota, returned on Aug. 28 from a visit to Germany and France which began on June 11, 1910. Prof. Springer spent his sabbatical year investigating the teaching methods and shop-testing practices in the two countries mentioned.

MR. J. J. CAGNEY, until recently general manager of the Central Georgia Power Company, is now general manager of the Wawaitin Falls power development on the Matagami River, Golden City, Ontario, now under construction, which will supply motor and lighting service to all of the principal towns in the Porcupine district.

MR. S. Z. DE FERRANTI, president of the British Institution of Electrical Engineers, will be in Chicago on private business about the middle of September, and will probably join the party consisting of Messrs. Charles H. Merz, Arthur Wright, H. A. Couves and Mr. Raven, all English visitors, in inspecting various Eastern electrical plants and installations.

MR. J. FRANK DOSTAL has resigned as superintendent of the electrical department of the Denver Gas & Electric Company to become general manager of the Colorado Springs Electric Company. Mr. Dostal started ten years ago as a youth at the bottom of the ladder with the Denver Company, which he has served as engineer, chief engineer and, for the past several years, as electrical superintendent. As national "Jupiter," Mr. Dostal will preside over the approaching meeting at Denver of the Sons of Jove.

MR. ALBERT SCHEIBLE has been appointed secretary of arrangements by the convention committee having in charge the preparations for the annual convention of the Illuminating Engineering Society, to be held at the Congress Hotel, Chicago, on September 25 to 28, inclusive. Mr. Scheible is an ex-chairman of the Chicago section of the society and well fitted to take active charge of the convention arrangements under the direction of the convention committee, of which Mr. John F. Gilchrist, 120 West Adams Street, Chicago, is chairman.

PROF. J. D. HOFFMAN, formerly in charge of mechanical design instruction at Purdue University, on Sept. 1 took up his new duties as head of the mechanical-engineering school of the University of Nebraska, at Lincoln, where he succeeds Prof. Charles Russ Richards, who has been appointed assistant dean of engineering at the University of Illinois. Professor Hoffman, like Professor Richards, was graduated from Purdue in 1890, and has been a member of the faculty of his alma mater ever since. He has devoted special attention to heating, ventilating and refrigerating subjects, on which he has prepared several standard text-books, and is a past-president of the Society of Heating and Ventilating Engineers.

MR. EMIL G. SCHMIDT has been elected president of the County Traction Company, of Chicago, which operates electric surface railways in outlying portions of Cook County adjoining Chicago. Mr. Schmidt, who until a year ago was operating vice-president of the Union Railway, Gas & Electric Company, of Springfield, Ill., is well known to electrical men. That company operated various public-utility properties in Springfield, Peoria and Rockford, Ill., and Evansville, Ind. Mr. Schmidt has been in the public service field since 1887, being for some time connected with the central-station and electric railway interests of Sandusky, Ohio. He is known as an organizer and a builder up of systems, and as such will no doubt weld the somewhat detached lines of the County Traction Company into one complete system.

MR. H. B. BROOKS, of the electrical division of the Bureau of Standards, has been temporarily transferred to the Bureau of Manufactures of the Department of Commerce and Labor, to investigate trade conditions abroad with respect to electrical industries, especially measuring instruments and meters and the materials entering into their construction. He sailed Aug. 22 for Germany, and will spend a number of months in visiting the electrical instrument makers and laboratories of England, Germany, France and other countries. He will act as a delegate to the International Electrotechnical Congress at Turin, Italy, on behalf of the National Bureau of Standards and the American Institute of Electrical Engineers. Suggestions in regard to his work will be welcome, and may be addressed to him "care Bureau of Manufactures, Washington, D. C."

GANO DUNN.—Owing to an office blunder, a personal note relating to Mr. Gano Dunn appeared only in part of our issue of last week, having been omitted from the first copies printed. The note is there

fore here repeated: Mr. Gano Dunn, who for some years has been first vice-president, chief engineer and a director of the Crocker-Wheeler Company, has resigned from that company in order to accept an important engineering and executive position. Mr. Dunn will sail shortly for Europe to attend, as president of the American Institute of Electrical Engineers, the meeting during the Turin Exposition of the International Electrotechnical Commission, to be held on Sept. 7, 8 and 9, and also the following meeting of the International Electrical Congress, Sept. 10 to 17.

Mr. Dunn sailed on the *St. Paul* on Saturday, Aug. 26, and will return home about Oct. 11.

MR. CHARLES H. MERZ, of Merz & McClellan, London and Newcastle, England, consulting engineers, and Mr. Arthur Wright, of London, well known as the originator of the Wright demand system of charging for central stations, arrived in New York on Saturday, Aug. 26, on the *Kaiserin Auguste Victoria.* They were met at the dock by Mr. Samuel Insull, president of the Commonwealth Edison Company, Chicago, and Mr. John W. Lieb, Jr., vice-president of the New York Edison Company. Messrs. Merz and Wright are on a visit to this country partly for pleasure and partly to examine electrical plants and methods in the United States. Escorted by Mr. Insull they left for Chicago on Saturday afternoon, and on Sunday they were entertained by Mr. Insull at his country place at Libertyville, Ill. On Monday the visitors were guests at a staff luncheon of the Commonwealth Edison Company, meeting also Mr. H. M. Byllesby, Mr. O. E. Osthoff and Mr. Frederick Sargent, of Chicago, who were fellow guests. Afterward they visited some of the Commonwealth Edison plants, and in the evening they left for the Pacific Coast. Returning East about the middle of September, Messrs. Merz and Wright will meet in Chicago Mr. H. A. Couves, of Newcastle, one of Mr. Merz's assistants, and also Mr. Raven, chief engineer of the North Eastern Railway of England, and they will thereafter attend the Edison convention at Spring Lake, N. J., leaving for home probably about the last of September.

Obituary.

MR. J. B. HUBBARD, Pittsburgh manager for the Adams-Bagnall Electric Company, died in Niagara Falls, N. Y., on Aug. 16. Mr. Hubbard was making a business trip when he was taken ill with typhoid fever, and he died in a hospital. He had been with the Adams-Bagnall Company for about three years. Previously he was employed by the Doubleday-Hill Electric Company in Pittsburgh.

MR. SAMUEL A. RALL, formerly manager of the city sales department of the Electrical Appliance Company, of Chicago, and well known to Western electrical men, died about Aug. 1. Mr. Rall had not been engaged in electrical pursuits for several years, having established a contracting business at his home in La Grange, Ill. He was ill for some time before his death. Mr. Rall became a member of the Sons of Jove in 1906.

MR. MERTON H. BENTLEY, after an illness which extended through many months, died at his home in Chicago, Aug. 8. Mr. Bentley was born in Chicago thirty-nine years ago and spent the greater part of his life there. His interest in electricity was awakened when a mere child and at an early age he began stretching telephone and telegraph lines between his home and that of neighbors and boy friends. After learning telegraphy in this way and by association with night operators, near his home, he took charge of the railroad telegraph office at Kent, Ill., at the age of fifteen, and had the distinction of being the youngest telegraph operator and agent on record at that time. He then took up electricity as applied to transportation and at the age of nineteen had entire charge of the electrical equipment of the Cicero & Proviso street railway system, of Chicago. With a good knowledge of electricity from a practical standpoint, he received a technical course at the Rose Polytechnic Institute. He then entered the telephone field with the Chicago Telephone Company, holding various positions in all branches of the work. He was prominently identified with the engineering staff, having direct charge of all power work pertaining to the new exchanges, and later occupied the position of assistant to Mr. A. V. Abbott, who was then chief engineer of that company. About 1900 he entered the Independent field as superintendent of the New Telephone Company, at Indianapolis, Ind., now known as the Indianapolis Telephone Company. He then became interested in the manufacturing of telephone equipment and, after spending four months abroad in travel and investigation of the telephone equipment in the principal cities of Europe, he became identified with the telephone engineering department of the Western Electric Company, at Chicago. In 1908 he returned to the Chicago Telephone Company. For twenty years Mr. Bentley was a member of the American Institute of Electrical Engineers and a close student of all subjects pertaining to electricity in its various applications. His pastime was amateur photography, his first attempts along this line being made at the age of twelve. He had about 800 stereopticon slides which he had made himself from his own negatives taken on his many trips through this country and abroad. With a good stereopticon lantern he gave many private entertainments for his friends. He was a member of the Chicago Camera Club. The funeral services were held at his late residence, 155 North Scoville Avenue, Oak Park, Aug. 10, followed later by cremation at Graceland Cemetery and interment later at Forest Home in the family lot.

Trade Publications.

MOTORS AND DYNAMOS.—The Star Dynamo Company, Jefferson City, Mo., has bound in convenient form two bulletins and a price-list, one devoted to its direct-connected motors and generators and the other to its induction motors. The direct-current motors are built in sizes ranging from ¼ to 25 hp and the generators in sizes from ½ to 20 kw. The induction motors are built for two- and three-phase work, in sizes ranging from ½ to 20 hp. The various parts of the machines are illustrated and described.

TRANSFORMER OIL DRYER AND PURIFIER.—Bulletin No. 4872, just issued by the General Electric Company, describes an outfit for the purification of transformer oil of all kinds, crude petroleum for oil-fired furnaces, insulating varnish and japan, benzine used for cleaning purposes, transformer oil used for impregnating insulating pressboard and wood, cylinder oil used in certain types of electrical apparatus, and viscous insulating compounds. The apparatus consists of a filter press, a pump and a motor for driving. All are mounted on standard steel I-beams which form skids and greatly facilitate handling. The outfit may be mounted on iron wheels if desired.

BUSINESS NOTES.

GROUNDING RODS.—The Duplex Metals Company, Chester, Pa., announces that it makes copper-clad rods for grounding purposes.

SAN FRANCISCO CROCKER-WHEELER OFFICE.—The Crocker-Wheeler Company, opened on Sept. 1, offices in San Francisco, Cal., located at Room 400, First National Bank Building. Motors, generators and transformers of various sizes will be carried in stock in San Francisco for immediate coast shipments. Mr. John S. Baker, well known among the electrical trade on the Pacific Coast, has been placed in charge.

WESTERN ELECTRIC COMPANY'S RICHMOND BRANCH.—The Western Electric Company announces the establishment of a branch office at Richmond, Va., where a complete stock of telephone apparatus and general electrical supplies will be carried. Mr. H. W. Hall, formerly manager of the Denver office of the company, will be in charge of the Richmond office and with him will be associated specialists on the various lines handled.

THE EMIL GROSSMAN COMPANY has removed its "Red Head" spark plug factory to Detroit, Mich., where its new plant, consisting of three floors, is located at 844 Woodward Avenue. The local display-room has been removed from 874 Woodward Avenue to the above location. The plant is equipped with a battery of machines designed by the Emil Grossman Company's engineers especially for the production of an augmented line of spark plugs.

TAYLOR STOKERS.—The American Ship Windlass Company has recently received repeat orders for Taylor stokers from the General Electric Company of Pittsfield, Mass., making the fourth order for stokers; from the New York, New Haven & Hartford Railroad Company, for its new plant at Waterbury, Conn., making two orders for this plant, and from the Northern Ohio Traction and Lighting Company, Akron, Ohio, and the Solvay Process Company, Syracuse, N. Y.

NEW BRANCH OFFICES OF BRILLIANT LAMP COMPANY.—The Brilliant Electric Company, Cleveland, Ohio, has opened at 151 New Montgomery Street, San Francisco, Cal., a branch office which will be in charge of Mr. E. D. Hand, the company's Pacific representative. A "Brilliant" branch office has also been opened in Los Angeles, Cal., and will be under the management of Mr. Clarence W. Cole, who until recently represented the company in Cleveland and vicinity.

INSULATING MATERIAL.—A letter has been received from the Isolatoren-Werke, Munich, Bavaria, in relation to the use in this country of the name "Gummon" as applied to an insulating material, and referring to an article entitled "New Molded Insulator" which appeared in the issue of April 6. The communication states that the material thus originally designated was invented and patented by Robert Muller, formerly employed by the Munich firm, but that the inventor of the insulating material now known abroad by the trade name "Gummon" is a director of the firm, Herr Ernest Eppner, Dipl. Engineer, of Grafelfing. Manufacture under the inventions of the latter, which are not patented, is carried on by a secret process for which, the letter states, the rights for the United States, Mexico and Canada are held exclusively by the Dickinson Manufacturing Company, Springfield, Mass.

BUCKEYE SUMMER CONVENTION.—Thirty-one members of the Buckeye Electric Company's sales force held their annual sales conference at Association Island during the week of August 14. Accompanying the party were the wives of six of the men and a number of guests closely associated with the Buckeye organization. The conference was most successful, both the business meetings and the social features being enthusiastically attended. Addresses were made by Messrs. F. S. Terry, Ward, Harris, Henneger and Edwards of the engineering department of the National Electric Lamp Association, and by Mr. C. Walter Jones, sales manager of the Holophane Company. A fishing excursion, a shore dinner, a dance and a "show" composed the amusement features of the week. In summing up the last year's business and outlining future policies, Mr. L. P. Sawyer, general manager of the company, expressed complete confidence in the business outlook and mapped out a program of aggressive development of the coming season.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

ALABAMA LIGHT & TRACTION ASSOCIATION. Secretary, Geo. S. Emery, 11 N. Royal St., Mobile, Ala. Annual convention in November, 1911.

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa. Next semi-annual meeting at Toronto, Canada, September 21-23, 1911.

AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION. Secretary, Dr. J. Willard Travell, 27 East 11th St., New York. Next meeting at Philadelphia, Pa., Sept. 5, 6 and 7, 1911.

AMERICAN INSTITUTE OF CONSULTING ENGINEERS. Secretary-Treasurer, Eugene W. Stern, 103 Park Ave., New York City. The Council meets the first Friday of every month.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Honorary secretary, Ralph W. Pope; acting secretary, F. L. Hutchinson. Engineering Societies Building, 29 West 39th St., New York. Meetings, second Friday of each month, excepting, June, July, August and September.

AMERICAN ELECTRIC RAILWAY ACCOUNTANTS' ASSOCIATION. Secretary, H. E. Weeks, Davenport, Ia. Annual convention, Atlantic City, N. J., October 9-13, 1911.

AMERICAN ELECTRIC RAILWAY ENGINEERING ASSOCIATION. Secretary, Norman Litchfield, Interborough Rapid Transit Company, New York. Annual convention, Atlantic City, N. J., Oct. 9-13, 1911.

AMERICAN ELECTRIC RAILWAY ASSOCIATION. Secretary, H. C. Donecker, Engineering Societies Building, 29 West 39th St., New York. Annual convention, Atlantic City, N. J., Oct. 9-13, 1911.

AMERICAN PHYSICAL SOCIETY. Secretary, Ernest Merritt, Cornell University, Ithaca, N. Y.

ARKANSAS ASSOCIATION OF PUBLIC UTILITY OPERATORS. Secretary, W. J. Thorpe, Little Rock, Ark.

ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS. Secretary, James Farrington, Steubenville, Ohio.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Secretary, P. W. Drew, 135 Adams St., Chicago.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS. Secretary, J. Andreucetti, Chicago & Northwestern Railway, Chicago. Next annual meeting (Hotel La Salle, Chicago), November 6 to 10, 1911.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, N. T. Wilcox, Lowell, Mass. Next convention, Spring Lake, N. J., Sept. 19-21, 1911.

COLORADO ELECTRIC LIGHT, POWER & RAILWAY ASSOCIATION. Secretary, F. D. Morris, 323 Hagerman Building, Colorado Springs, Col. Annual convention, Glenwood Springs, Col., Sept. 13-15, 1911.

ELECTRIC VEHICLE ASSOCIATION OF AMERICA. Secretary, Harvey Robinson, 124 West 42d St., New York. Meetings, fourth Tuesday of each month.

ELECTRIC CLUB, CHICAGO. Secretary, N. F. Ooright, 1500 American Trust Bldg., Chicago. Meets every Wednesday noon, 303 Wabash Ave.

ELECTRICAL CONTRACTORS' ASSOCIATION OF NEW YORK STATE. Secretary, Geo. W. Russell, Jr., 25 West 42d St., New York.

ELECTRIC TRADES ASSOCIATION OF PHILADELPHIA. Secretary, J. W. Crum, 1324 Land Title Building, Philadelphia, Pa. Meetings, second and fourth Thursday of each month.

ELECTRICAL CONTRACTORS' ASSOCIATION OF STATE OF MISSOURI. Secretary, Ernest S. Cowie, 1413 Grand Ave., Kansas City, Mo.

ELECTRICAL SALESMEN'S ASSOCIATION. Secretary, Francis Raymond, 125 Michigan Ave., Chicago. Annual meeting, Chicago, January each year.

ELECTRICAL TRADES ASSOCIATION OF CANADA. Secretary, William R. Staveley, Royal Insurance Building, Montreal, Can.

ELECTRICAL CREDIT ASSOCIATION OF CHICAGO. Secretary, Frederic P. Vose, Marquette Building, Chicago. Annual meeting, Chicago, Nov. 2, 1911.

ELECTRICAL TRADES ASSOCIATION OF THE PACIFIC COAST. Secretary, Albert H. Elliott, Harding Building, 34 Ellis St., San Francisco, Cal. Monthly meeting, San Francisco, second Thursday of each month.

ELECTRICAL TRADES SOCIETY OF NEW YORK (Member National Electrical Credit Association). Secretary, Franz Neilson, 80 Wall St., New York. Board of Directors meets second Thursday of each month.

EMPIRE STATE GAS AND ELECTRIC ASSOCIATION. Secretary, Charles H. B. Chapin, Engineering Societies Building, 29 West 39th St., New York.

FLORIDA ELECTRIC LIGHT & POWER ASSOCIATION. Secretary, H. C. Adams, West Palm Beach, Fla.

ILLINOIS STATE ELECTRICAL ASSOCIATION. Secretary, H. E. Chubbuck, Peoria, Ill.

ILLUMINATING ENGINEERING SOCIETY. Secretary, P. S. Millar, Engineering Societies Building, 29 West 39th St., New York. Sections in New York, New England, Philadelphia and Chicago. Annual convention, Sept. 25-27, 1911, Chicago, Ill.

INDEPENDENT ELECTRICAL CONTRACTORS' ASSOCIATION OF GREATER NEW YORK. Secretary, L. H. Woods, 2355 Jerome Ave., New York.

INDIANA ELECTRIC LIGHT ASSOCIATION. Secretary, J. V. Zartman, Indianapolis. Ind.

INTERNAL COMBUSTION ENGINE ASSOCIATION. Secretary, Chas. Kratch, 416 W. Indiana St., Chicago. Meetings, second Friday of each month.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, C. R. George, Houston, Tex. Next convention at Young's Hotel, Atlantic City N. J., Sept. 12-15, 1911.

INTERNATIONAL ELECTROTECHNICAL COMMISSION (international body representing various national electrical engineering societies contributing to its support). Secretary, C. le Maistre, 28 Victoria St., Westminster, London, S. W., England.

IOWA ELECTRICAL ASSOCIATION. Secretary, W. N. Keiser, Dubuque, Ia.

IOWA STREET & INTERURBAN ASSOCIATION. Secretary, L. D. Mathes, Dubuque, Ia.

KANSAS GAS, WATER & ELECTRIC LIGHT ASSOCIATION. Secretary, James D. Nicholson, Newton, Kan. Next meeting, Independence, Kan., Sept. 21 and 22, 1911.

LOUISIANA ELECTRICAL ASSOCIATION. Secretary, W. H. Bower Spangenberg, 627 Poydras St., New Orleans, La. Meets third Monday of each month.

MAINE ELECTRICAL ASSOCIATION. Secretary, Walter S. Hyman, Waterville, Maine.

MICHIGAN ELECTRICAL ASSOCIATION. Secretary, Herbert Silvester, 18 Washington Boulevard, Detroit, Mich.

MINNESOTA ELECTRICAL ASSOCIATION. Secretary, T. C. Gordon, Little Falls, Minn.

MISSOURI ELECTRIC, GAS, STREET RAILWAY & WATER ASSOCIATION. Secretary, N. J. Cunningham, Springfield Gas & Electric Co., Springfield, Mo.

NATIONAL ARM, PIN & BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind.

NATIONAL DISTRICT HEATING ASSOCIATION. Secretary, D. L. Gaskil, Greenville, Ohio.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton, 41 Martin Building, Utica, N. Y.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Executive secretary, T. C. Martin, Engineering Societies Building, 33 West 39th St., New York. Next annual convention at Seattle, Wash., second week in June, 1912.

NATIONAL ELECTRIC LIGHT ASSOCIATION, CANADIAN SECTION. Secretary, T. S. Young, 220 King St. West, Toronto, Can.

NATIONAL ELECTRIC LIGHT ASSOCIATION, GEORGIA SECTION. Secretary-Treasurer, H. M. Corse, Columbus Railroad Company, Columbus, Ga. Next annual meeting at Columbus, Ga., Sept. 26 and 27, 1911.

NATIONAL ELECTRIC LIGHT ASSOCIATION, MISSISSIPPI SECTION. Secretary, A. H. Jones, McComb City, Miss.

NATIONAL ELECTRIC LIGHT ASSOCIATION. NEBRASKA SECTION. Secretary-Treasurer, S. J. Bell, David City, Neb.

NATIONAL ELECTRIC LIGHT ASSOCIATION, NEW ENGLAND SECTION. Secretary, Miss O. A. Bursiel, 149 Tremont St., Boston, Mass. Next annual meeting at Mt. Washington, Bretton Woods, N. H., Sept. 17-29, 1911.

NATIONAL ELECTRIC LIGHT ASSOCIATION, PENNSYLVANIA SECTION. Secretary-Treasurer, Van Dusen Rickert, Pottsville, Pa. Next annual meeting at Exposition Park, Conneaut Lake, Crawford Co., Pa., Sept. 5-8, 1911.

NATIONAL ELECTRIC INSPECTORS' ASSOCIATION. Secretary, T. H. Day, 27 Pliny St., Hartford, Conn.

NATIONAL ELECTRIC CREDIT ASSOCIATION. Secretary, Frederic P. Vose, 343 Marquette Bldg., Chicago.

NATIONAL FIRE PROTECTION ASSOCIATION. Secretary, R. Sweetland, 141 Milk St., Boston, Mass. Next biennial meeting, March, 1913.

NATIONAL INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Joseph B. Ware, Grand Rapids, Mich.

NEW ENGLAND STREET RAILWAY CLUB. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

NEW ENGLAND ELECTRICAL TRADES ASSOCIATION. Secretary, Alton F. Tupper, 84 State St., Boston, Mass. Directors meet first Wednesday of each month.

NEW ORLEANS ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, L. G. Marks, 312 Carondelet St., New Orleans, La. Meetings, second and fourth Tuesday of each month.

NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, Engineering Societies Building, 33 West 39th St., New York.

NORTHWEST ELECTRIC LIGHT & POWER ASSOCIATION. Secretary, N. W. Brockett, Cataract Building, Seattle, Wash.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL & STEAM ENGINEERS. Secretary, Prof. I. E. Sanborn, Ohio State University, Columbus, Ohio.

ORDER OF REJUVENATED SONS OF JOVE. Mercury (Secretary), R. M. Van Vleet, 1157 Monadnock Bldg., Chicago, Ill. Annual meeting, Denver, Col., Oct., 16-18, 1911.

PITTSBURGH ELECTRIC BOOSTER CLUB. Recording Wattmeter, O. R. Rombach, 919 Liberty Ave., Pittsburgh, Pa. Meetings, fourth Monday of each month.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, H. H. Norris, Cornell University, Ithaca, N. Y.

SOCIETY OF WIRELESS TELEGRAPH ENGINEERS. Secretary, E. B. Moore,

39 Trinity Place, Boston, Mass. Monthly meeting, first Saturday of each month, at the Massachusetts Institute of Technology, Boston.

Southwestern Electrical & Gas Association. Secretary, D. G. Fisher, 1316 Commerce St., Dallas, Tex.

Street Railway Association of the State of New York Secretary, C. G. Reel, Kingston, N. Y.

Vermont Electrical Association. Secretary-Treasurer, A. B. Marsden, Manchester, Vt.

Western Association of Electrical Inspectors. Secretary, W. S. Boyd, 145 Monroe St., Chicago, Ill.

Western Society of Engineers. Electrical Section, formerly Chicago Electrical Association. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago. Regular meetings, first Friday of each month, except January, July and August. Annual meeting, first Tuesday after Jan. 1, each year.

Wireless Institute. Secretary, Alfred N. Goldsmith, College of the City of New York, New York.

Wisconsin Electrical Association. Secretary, George Allison, Stephenson Building, Milwaukee, Wis. Next annual meeting, Milwaukee, January, 1912.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED AUG. 22, 1911.

[Prepared by Robert Starr Allyn, 16 Exchange Place, New York.]

1,001,023. CIRCUIT-CONTROLLING SYSTEM; J. H. Hall, Cleveland, Ohio. App. filed Nov. 23, 1910. Magnetically operated switch and resistance with circuits for protecting a motor against overload.

1,001,032. ELECTRIC SWITCH; H. K. Hirst, New Bedford, Mass. App. filed Nov. 5, 1909. Push-button wall type with oscillating arm.

1,001,035. TERMINAL BLOCK FOR HIGH-TENSION APPARATUS; T. Hubert, New York, N. Y. App. filed Oct. 17, 1907. An insulating block with openings and sockets for the terminals.

1,001,046. SIGNALING-HORN; A. A. Kent, Philadelphia, Pa. App. filed Feb. 28, 1910. An integral casing with electromagnetically vibrated diaphragm.

1,001,047. ELECTRICAL POWER TRANSMISSION; H. Kleinschmidt, Berlin, Germany. App. filed Sept. 11, 1909. Two separate machines of unipolar type. The stators form a common casing for the rotors. For automobiles driven by gas engines, etc.

1,001,049. PROCESS OF WELDING SHEET METAL; C. C. Knipe, Palo Alto, Cal. App. filed Dec. 1, 1905. Simultaneously localized heat and pressure are applied to weld thin planished sheet metal.

1,001,054. GROUND-WIRE FASTENERS; M. H. Lawrence, Larned, Kan. App. filed March 15, 1911. The wire is wedged between the tapered portion of a driven ground rod and a tapered sliding sleeve.

1,001,068. APPARATUS FOR GOVERNING THE PASSAGE OF CARS OR VEHICLES ALONG A RAILWAY; W. P. Neubert, Swissvale Borough, Pa. App. filed Jan. 17, 1911. Interlocking system of mechanical and electrical control.

1,001,070. LOCK-OUT TELEPHONE SYSTEM; N. E. Norstrom, Chicago, Ill. App. filed June 6, 1910. For party lines to prevent interference. Step-up devices to control a cycle of operations.

1,001,091. DEVICE FOR INDICATING VARIATIONS IN SYNCHRONOUS RUNNING OF KINEMATOGRAPHS AND GRAMOPHONES; F. A. Thomassin, Streatham, Eng. App. filed April 12, 1909. A hand is rotated in one direction with one mechanism and its support is rotated in the opposite direction by the other mechanism.

1,001,105. MANUFACTURE OF ELECTRIC FILAMENTS; C. A. von Welsbach, Vienna, Austria-Hungary. App. filed Aug. 24, 1899. A filament containing metallic oxid and osmium is electrically heated to expel some of the gases and then reduce the oxid by the remaining gases.

1,001,135. FILAMENT SUPPORT; H. Gilmore, Brookline, Mass. App. filed Jan. 30, 1911. A sheet-metal filament support has a coefficient of expansion greater than that of the glass stem.

1,001,137. INSULATOR PROTECTOR; W. T. Goddard, Victor, N. Y. App. filed June 12, 1908. An arcing member secured on a support has a portion projecting into a flared portion of the insulator, and another arcing member is secured on the insulator.

1,001,152. ATTACHMENT FOR ELECTRIC MOTORS; W. A. Lawrence, Charlotte, N. C. App. filed Nov. 19, 1910. A holder is held by fusible material away from a signal-operating position to give an alarm in case the motor shaft runs loose or hot.

1,001,192. GAS-LIGHTING BURNER; E. A. and E. N. Fray, South Deerfield, Mass. App. filed Aug. 18, 1910. Electromagnetically operated ignition and gas-directing hood.

1,001,227. AERIAL FOR WIRELESS TELEGRAPHY AND TELEPHONY; W. E. D. Stokes, Jr., and G. W. Davis, New York, N. Y., and Galilee, N. J. App. filed Oct. 9, 1908. A series of vertically arranged wires and a switch for connecting any one to the receiving circuit.

1,001,228. RECEIVING CIRCUIT FOR WIRELESS TELEGRAPHY AND TELEPHONY; W. E. D. Stokes, Jr., and G. W. Davis, New York, N. Y., and Galilee, N. J. App. filed Oct. 9, 1908. A large plate connected with an aerial and arranged parallel with the ground to form a condenser.

1,001,236. ELECTROMAGNETIC SOUND-WAVE THERAPEUTIC APPARATUS; E. Bachelet, New York, N. Y. App. filed Aug. 7, 1908. Ear pieces with solenoid vibrators.

1,001,251. TROLLEY POLE; J. Coan, Westville, Ill. App. filed Nov. 13, 1909. Controlling device for holding the pole up, retracting it and assisting in replacing it.

1,001,271. MACHINE FOR ELECTRICALLY WELDING CHAIN LINKS; C. L. Hoff, York, Pa. App. filed Oct. 4, 1909. Mechanical devices for holding individual links and moving the welding electrodes toward and from each other.

1,001,313. ELECTROMAGNETIC SWITCH; H. W. Sheehy, Akron, Ohio. App. filed May 25, 1910. For electric street cars, etc. A movable magnet core carries a movable bar designed to contact with the rail to operate the switch frog.

1,001,330. ELECTRICAL PULL SOCKET; D. P. Wolhaupter, Washington, D. C. App. filed Jan. 28, 1911. A spring contact arm and a rotating cam with an insulating disk between the contacts and the operating member.

1,001,337. MINE-GAGE SIGNAL; L. Bayer, Willisville, Ill. App. filed June 6, 1910. A manually operable switch contact is carried by the car and adapted to engage stationary contacts at the side of the shaft.

1,001,339. REVERSING MECHANISM; G. Binder, Rochester, N. Y. App. filed April 5, 1911. For washing machines, etc.; driven by an electric motor. The reversing mechanism is driven continually in one direction and automatically reverses the driven member of the machine.

1,001,358. TRAIN-LIGHTING SYSTEM; J. P. Crouch and J. Etchells, Manchester, Eng. App. filed Nov. 27, 1909 Secondary battery and reversible dynamo and main switches brought into operation by reversal of the dynamo.

1,001,382. FILAMENT MOUNTING; E. S. Gardner, Acquackanonck, N. J. App. filed Dec. 28, 1910. The filaments are arranged in successive conical banks and staggered.

1,001,406. APPARATUS FOR GENERATING ELECTRICITY BY CHEMICAL MEANS; R. N. Hudson and E. C. Brice, Lexington, Ky. App. filed Oct. 28, 1909. Nested cups of vitreous, porous and carbon material and alloyed members and electrolyte.

1,001,449. METHOD OF PROCESS OF AND APPARATUS FOR EXTRACTING METALS FROM THE ORES THEREOF; J. H. Robertson, New York, N. Y. App. filed Oct. 12, 1910. A liquid solution containing a powder of the ore is subjected to the electrical effect of a plurality of short-circuited conducting elements.

1,001,453. ARC LAMP; W. Rühling, Berlin, Germany. App. filed April 19, 1911. An insulating barrier containing malachite and carbon separates the parallel electrodes and forms a conducting bridge when the arc is extinguished.

1,001,466. PROCESS OF EXTRACTING METAL FROM SOLUTIONS; E. E. Slaughter, Clifton, Ariz. App. filed Jan. 6, 1908. Iron and carbon are immersed in a copper solution and the copper precipitated and then extracted by heat.

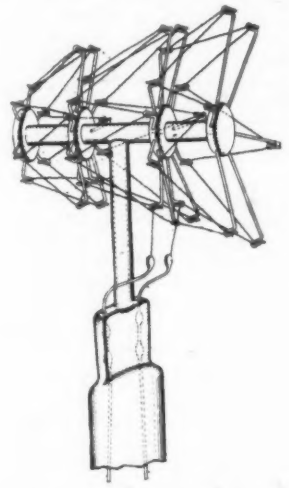
1,001,497. COMPOSITION OF MATTER CONTAINING ALUMINA AND MAGNESIA; T. B. Allen, Niagara Falls, N. Y. App. filed July 28, 1910. Homogeneous crystalline product of alumina and magnesia with less magnesia than in $MgAl_2O_3$. For abrasive use.

1,001,558. ELECTRIC TERMINAL CONTACT; W. E. Russell, Danbury, Conn. App. filed Jan. 31, 1911. The wire passes up through the center of a split post and is clamped down at the top by a cap.

1,001,570. COMPOSITION OF MATTER CONTAINING ALUMINA, MAGNESIA AND BORIC OXID; T. B. Allen, Niagara Falls, N. Y. App filed Nov. 9, 1910. Abrasive material, homogeneous, crystalline, insoluble in water and acids. Formed by melting the oxids with carbon.

1,001,571. COMPOSITION OF MATTER CONTAINING BERYLLIA AND ALUMINA; T. B. Allen, Niagara Falls, N. Y. App. filed Nov. 9, 1910. Not more than 18 per cent beryllia; formed by heating with carbon; homogeneous and crystalline.

1,001,572. METHOD OF TREATING ELECTROMETALLURGICAL



1,001,382.—Filament Mounting.

PRODUCTS; T. B. Allen, Niagara Falls, N. Y. App. filed Jan. 28, 1911. The products such as impure alumina are heated with a substance such as NaCl in the presence of O; to form abrasives.

1,001,589. ELECTROLYTIC CELL; H. S. Hatfield, Hove, Eng. App. filed Oct. 12, 1907. For transferring; as when impure copper is used as an anode and in the Wright mercury meter. The electrolyte is soluble and is saturated with an insulating substance to be transferred.